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THESIS

REVISION OF CAREER MARKSMANSHIP TRAINING REQUIREMENTS FOR THE UNITED STATES MARINE CORPS

by

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Current Marine Corps policy requires that all Marines below the rank of Gunnery Sergeant and with fewer than 13 years of service undergo annual rifle qualification. Annual marksmanship training is repetitive and only addresses the fundamentals of marksmanship, which Marines typically master in their first few years. Key features of marksmanship training are instilled at initial training for officers and enlisted Marines, but advanced training is seldom received outside infantry and select occupational fields. Operational tempo or limited range availability may also make it impossible for some Marines (or entire units) to attend. Analysis of all recorded marksmanship scores from the past 20 years shows no significant changes in proficiency for Marines continuing to conduct sustainment under the current or previous policy. The current Marine Corps policy can be adjusted to increase the overall lethality of the force by recognizing earlier proficiencies with marksmanship skills and allowing Marines who have shown proficiency to advance to intermediate and advanced combat marksmanship training. The Marine Corps can refocus resources by conducting fewer sustainment-level rifle qualifications, allowing units to more efficiently schedule marksmanship training commensurate with the Marine's level of proficiency.

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REVISION OF CAREER MARKSMANSHIP TRAINING REQUIREMENTS FOR THE UNITED STATES MARINE CORPS

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requirements for the degree of

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Current Marine Corps policy requires that all Marines below the rank of Gunnery Sergeant and with fewer than 13 years of service undergo annual rifle qualification. Annual marksmanship training is repetitive and only addresses the fundamentals of marksmanship, which Marines typically master in their first few years. Key features of marksmanship training are instilled at initial training for officers and enlisted Marines, but advanced training is seldom received outside infantry and select occupational fields. Operational tempo or limited range availability may also make it impossible for some Marines (or entire units) to attend. Analysis of all recorded marksmanship scores from the past 20 years shows no significant changes in proficiency for Marines continuing to conduct sustainment under the current or previous policy. The current Marine Corps policy can be adjusted to increase the overall lethality of the force by recognizing earlier proficiencies with marksmanship skills and allowing Marines who have shown proficiency to advance to intermediate and advanced combat marksmanship training. The Marine Corps can refocus resources by conducting fewer sustainment-level rifle qualifications, allowing units to more efficiently schedule marksmanship training commensurate with the Marine's level of proficiency.

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LIST OF ACRONYMS AND ABBREVIATIONS

CMP	Combat Marksmanship Program
CPP	Combat Pistol Program
CQB	Close Quarters Battle
CSV	Comma Separated Value
ELT	Entry-Level Training
FMF	Fleet Marine Force
HQMC	Headquarters Marine Corps
IAR	Individual Automatic Rifle
JMP	John's Macintosh Program
MCCMP	Marine Corps Combat Marksmanship Program
MCO	Marine Corps Order
MCRD	Marine Corps Recruit Depot
MCRP	Marine Corps Reference Publication
MCTFS	Marine Corps Total Force System
MOS	Military Operational Specialty
NATO	North Atlantic Treaty Organization
NPS	Naval Postgraduate School
OCS	Officers Candidate School
PMI	Primary Marksmanship Instructor
QUAL	Qualification
RCO	Rifle Combat Optic
SAS	Suite of Analytics Software
TFDW	Total Force Data Warehouse
TIS	Time in Service
TIG	Time in Grade
TBS	The Basic School
UNQ	Unqualified
USMC	United States Marine Corps
YOS	Years of Service
WFTBN	Weapons Field Training Battalion

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I. INTRODUCTION

A. THE PURPOSE OF THIS RESEARCH

Extensive research and experimentation has been conducted over the years to refine the methods used to train in the art and science of marksmanship (Evans, Dyer, & Hagman, 2000). The goal of the majority of marksmanship research and experimentation has been to understand the human interaction with the weapon system and what it takes to hit your target. Advances in technology, overall understanding of scientific principles, and training have evolved to give mankind a staggering knowledge since the implementation of firearms.

The fundamental purpose of marksmanship training is to produce the skills required of a human being to operate a firearm and engage targets with maximum accuracy under a range of environmental fluctuations. The military's application of firearms has a myriad of purposes such as protection, deterrence, preservation, as well as destruction of opposing forces. The Marine Corps has built a reputation as a military force with exceptionally high standards of marksmen's excellence.

The training and evaluation of marksmanship skills has evolved with the weapons systems issued to the individual Marine (C. Beltran, personal communication, Nov 10, 2015). Lighter weapons, better target acquisition equipment, focused training, and years of collective combat experience have helped the Marine Corps achieve new heights in overall effectiveness in shooting wars. The Marine Corps may be ready as a force to make a significant shift in marksmanship training that can continue to focus on fundamental marksmanship while maximizing the resources required to sustain and increase individual marksmanship skills.

The primary purpose for this research is to present an argument in support of adapting the requirements of the Marine Corps Combat Marksmanship Program (MCCMP) from the current policy to a more progressive program. This research seeks to provide sufficient evidence to guide changes to policy to more efficiently provide marksmanship training at the appropriate level of skill to the total force. The study

reflects the limitations and benefits of annual rifle qualification for Marines at different stages over a 20-year period. This research attempts to describe the effects of continued marksmanship training as it relates to the overall proficiency throughout the Marine Corps. The study highlights the relative improvement of marksmanship reported throughout the Marine Corps Total Force System (MCTFS) in comparison to the perceived sustainment received during Marine Corps annual qualifications.

B. RESEARCH QUESTIONS

Should the Marine Corps continue to enforce the current policy outlined in *Marine Corps Order (MCO) 3574.2L*, encl., 1, para. 13, regarding time in service and rank requirements to qualify annually? Current policy provides an exemption to gunnery sergeant and above and officers with 13 years in service (United States Marine Corps [USMC], 2014). Can the Marine Corps adjust this policy to better reflect individual marksmanship capability? Does entry-level training give Marines the basic skills to allow them to progress as a combat shooter through their careers? Should resources be reallocated to intermediate and advanced marksmanship training for Marines who have shown proficiency in the fundamentals of marksmanship?

Additional subordinate questions that this research answers:

- Question 1: Is there a significant trend in marksmanship as reported by rifle qualification scores over the past 20 years, as the Marine Corps has undergone significant changes in weapons and optics?
- Question 2: Can the evaluation of all rifle range scores derived from the total force from 1994–2014 help to explain who is typically attending annual marksmanship training.
- Question 3: Does previous research support annual progression of marksmanship training versus the current repetition of previous fundamental instruction with senior NCOs and officers?

C. RESEARCH GOAL

The goal of this research is to evaluate the performance of the Marine Corps marksmanship program and its ability to produce improvement in marksmanship skill over a Marine's career. Traditional sustainment techniques have been carried over into

new Marine Corps orders for two decades. Repetition of annual qualification may give Marines an opportunity to upgrade their shooting badges but it will not upgrade their combat-effective shooting capability. Adapting a progressive format of qualification administered after entry-level training can capitalize on available resources.

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II. MASTERING MARKSMANSHIP

A. THE KEY TO SUCCESS ON THE BATTLEFIELD

Marksmanship is a heavily studied field for many reasons. The application of deadly force with a rifle to kill the enemy in combat is the primary reason the military concerns itself with the concepts and skills required to operate weapon systems. Shooting for sport, as a competitor or as a hunter, has different requirements for training and a different conceptual outcome. The unique aspect of preparing to take a human life with the application of deadly force requires additional attention when studying military marksmanship. The psychological effects and physiological act of pulling the trigger when a human being is the target has been the subject of many academic works and of many personal conversations over the author's 21 years as a Marine infantryman. The experiences gained during a life devoted to the application of precision fire have helped to influence the author's position of this particular research subject. Narrowing the field of works to those most relevant to the study of Marine Corps marksmanship is a significant challenge. To establish relevancy, previous academic studies relating to marksmanship helped to build a knowledge base of marksmanship complexity.

B. MARINE CORPS ORDERS GOVERNING MARKSMANSHIP TRAINING

1. Current Orders

The Marine Corps marksmanship program emphasizes accuracy and combat preparations to engage enemy combatants in a way that other services may not. The application of live-fire training techniques across the whole force is unique to the Marine Corps. Other services have limited requirements for marksmanship training to specific occupational specialties. *Marine Corps Order 3574.2L* 2014 prescribes the appropriate training and evaluation for every Marine. Revisions to MCO often come to the fleet Marine force (FMF) after a marksmanship symposium held periodically by Headquarters Marine Corps (HQMC). The Marine Corps looks to its Marine Gunner community for expertise and guidance to continue revising and rethink ranges, weapons, tactics, and

training to keeping the Corps at the forefront of these deadly skill sets (M. Ventrone, personal communication, 2015).

2. Previous Orders

From 1994 to 1999, *MCO 3574.2H* governed marksmanship training, followed by *MCO 3754.2J* and *MCO 3574.2J* with one change in October 2000, and *MCO 3574.2K* in 2007, before the current *MCO 3574.2L* took effect in 2014. Each order defines the scores that must be achieved to qualify as a marksman, sharpshooter, or expert. The points range required for each qualification level changes with each order. Comparison of the numerical values across scores for a Marine who shoots on the range at different times in his career governed by different orders does not give a solid numerical value change that can be seen as better or worse unless a threshold qualification score is crossed. If a Marine fires at expert level each time he goes to the range, we do not consider what Marine Corps order he was firing under at his last range detail. Some subjectivity is naturally built into the calculation of a Marine's scores across all the orders under which he may have fired.

The Fleet Marine Field Manual (FMFM 0-9), *Firing for the M16A2 Rifle* (1995), explicitly details the mechanics required to successfully engage a target or enemy combatant with the Marine Corps service rifle. The manual gives step-by-step instructions and pictures for visual learners. Field manuals and doctrinal publications are critical tools that guide the physical actions of all Marines preparing to fire their weapons. The continuous actions required to maintain sight alignment and proper sight picture on a target, while properly squeezing the trigger during a natural breathing pause, become a primarily mental rhythm (Kerick et al., 2000). Increased speed and efficiency by a rifle marksman can be achieved through proper mental exercises and techniques (Berka et al., 2008). The techniques evolve continuously with the Marine Corps and technology.

C. ENTRY-LEVEL TRAINING

The United States Marine Corps has always been a selective organization that prides itself on the exceptional quality of Marine that graduates from recruit training. The

Marine Corps places considerable emphasis on quality control in the initial recruiting process to ensure that the recruits sent to the two basic training depots possess the mental and physical fortitude required to earn the coveted title of United States Marine. Many of the recruits who attend training have never received any training in weapons handling or marksmanship. The Marine Drill Instructors indoctrinate the recruits in the profession of arms throughout the 13 weeks of training by fostering an intimate relationship between the recruit and their weapon. The M16A2 service rifle becomes an extension of the recruit's body through hours of weapons handling and close-order drill. Constant maintenance and care give the recruit a repetitively built knowledge of their weapon.

During recruit training and The Basic School (TBS), every Marine must master their weapon at the rifle range where they receive their initial training and primary evaluation as a Marine marksman. Every Marine qualifies as a marksman, sharpshooter, or expert with the M16A4 or M4 carbine service rifle during entry-level training. Once a Marine completes initial education in his or her primary military operational specialty (MOS), they report to their initial duty station.

Every Marine Corps unit is required by Marine Corps Order to complete marksmanship sustainment training (USMC, 2014). The sustainment of marksmanship skills should be the most fundamental common ground that connects all Marines. The Marine Corps has upheld a reputation as a combat-ready war-fighting organization throughout its history.

A core principle that separates the Marine Corps from other U.S. armed services is that all Marines, regardless of military specialty, are supposed to remain proficient with a rifle during their tour of duty. Non-combat arms military specialties in the armed forces may receive very limited rudimentary weapons handling training at some point in their service, but are not required to maintain a high level of proficiency. Figure 1 helps the reader visualize the care and attention that is given to weapons familiarization during entry-level training that carries over to the Marine's understanding of the rifles operation and mechanical makeup. The frequent maintenance disassembly and assembly helps the Marine to know the intricate details of the weapons parts, which helps them to understand what can go wrong during firing, allowing for faster remediation. This understanding

translates to the rifle range to ensure the Marine operates the weapons without issue while firing.

Figure 1. Fundamentals of Marines Corps Marksmanship

Source: C. Druery (n.d.) Retrieved Nov 12, 2015 from http://media.dma.mil /2012/May/ 3/242460/-1/-1/0/120503-M-0000L-014.jpg

D. FUNDAMENTALS OF MARKSMANSHIP

The building blocks that prepare Marines to succeed with the employment of their rifle are generally known as the Fundamentals of Marine Corps Marksmanship (FMCM). The FMCM are a specific set of procedures that the Marine Corps has identified as critical to the accurate employment of a rifle against any targets (USMC, 2001). Many of the FMCM apply in every situation from static known-distance firing ranges to dynamic combat engagements.

A Marine's success during his annual qualification often depends on his mastery of fundamental techniques that are instructed and practiced extensively before the first live round of ammunition is fired. Steady hands, solid foundation, breath control, trigger

control, trigger squeeze, sight alignment, sight picture, muscular tension, bone-on-bone support, natural positioning, and mental concentration all play critical roles in each Marine's accuracy (Thompson, Morey, Smith, & Osborne, 1981).

Figure 2 shows a Marine receiving advice and instructions from a primary marksmanship instructor (PMI). PMIs play a key role in rifle range details by providing advice to the shooters that are assigned to them. A Marine can become a PMI by attending a formal course where the Marine learns techniques of instruction in marksmanship. PMI and coaches are typically available to a Marine while preparing and conducting annual qualification. The shooter works with the PMI and coaches to identify mistakes the shooter is making in execution that can be corrected to result in more consistent accurate engagement with the rifle. Without the assistance of a PMI or coach the Marine is left to his or her own knowledge and experience to make the best choices.

As a Marine gains experience and confidence in shooting skills, coaches and PMIs become less important to the success of the shooter, but young Marines seldom have the experience and consistent application of FMCM to be left to their own devices while firing. Without identification of mistakes the shooter is making from an outside observer, it is unlikely the shooter can take appropriate corrective actions.

Figure 2. Known Distance Firing

Source: Bridget M. Keane, http://media.dma.mil/2012/May/1/242459/- 1/-1/0/120501-M-0000L-011.jpg

All Marines are given instruction and practical application in these fundamental skills but it is the responsibility of each Marine to concentrate on these aspects of shooting and incorporate as many as possible in the time allowed. The level of accuracy that can be achieved by each Marine cannot easily be measured due to the extensive physiological and mental variables that would be required. Weapons, technology, training techniques, and average intelligence of the Marine Corps have improved significantly over the past 30 years as a reflection of advancement in society in general.

Marines become increasingly confident in their marksmanship skills as they master the fundamentals and learn advanced shooting techniques. The engineering, ergonomics, and accessories of the evolving M16 style service rifle improve the weapons handling and accuracy at distances out to eight hundred meters. Marines become intimately familiar with the ergonomics and intricate details of handling a rifle during entry-level training. There are few hours during a typical day at entry-level training when a recruit or candidate is not handling a rifle. The familiarization and comfort achieved through continuous handling helps to instill a sense of pride and confidence in the future Marines that carries over to their ability to fire the weapons accurately.

Marine recruits conduct detailed weapons maintenance, which serves to ensure that each individual can clean, inspect, lubricate, and properly disassemble or assemble the weapon. Since the M16 style rifle is prone to stoppage while firing if it is dirty, the Marine Corps ensures all Marines have the skills required to maintain the weapon (Osborne & Smith, 1986).

E. MARINE CORPS SUSTAINMENT TRAINING

A Marine is no longer considered entry level once they complete recruit training for enlisted Marines, and The Basic School for officers. Once the Marine has reported to an operational unit they are required to conduct sustainment training of the marksmanship skills learned at entry-level training. The distinction between entry-level and sustainment training is important to differentiate what set of qualification criteria apply to each Marine.

Current Marine Corps policy establishes an incentive for enlisted Marines to maintain expert or to improve their marksmanship by receiving points toward promotion. An expert qualification gives a Marine 100 points on their composite score toward promotion. Once a Marine achieves expert it is beneficial for that Marine to maintain the expert qualification and 100 points until achieving promotion. Marines often avoid rifle range details for as long as the points remain on their record to avoid potentially firing a worse score that may not afford the full points toward promotion. (C. Beltran, personal communication, 2015).

Sustainment training may only occur once or twice during a Marine's time in the service and should only represent a small portion of training a Marine receives in regard to weapons handling and marksmanship. The policy specifies who must attend, yet Marines often seem to make every attempt to avoid subsequent range details when possible with few exceptions. Marines are selected by a selection boards to the ranks above sergeant which removes the incentive to qualify for composite score but adds a level of competition between peer groups to obtain higher scores to be represented at selection board proceedings. Once a Marine achieves the rank of gunnery sergeant or above, or has served 13 years on active duty, MCO no longer requires that Marine qualify annually with the rifle (USMC, 2014). Commanders are given the latitude to make decisions as to who is required to attend sustainment training during regular operations and often must weigh the urgency of training requirements with the probability that a Marine needs a score to be promotable.

As outlined in the MCO 3574.L appendices A, B, and C, the Table 1, Table 1A, and Table 2 courses of fire are not optimally designed to increase the combat focused marksmanship capability of the shooters. The current annual qualification tables of fire are designed to refresh the fundamental skills that were introduced and possibly applied during entry-level training (USMC, 2014).

New courses of fire have been refined by Headquarters Marine Corps and depicted in Table 3 of this document. The intermediate and advanced tables of fire have been designed to more closely replicate the conditions a Marine may face in a combat situation when faced with an enemy combatant. The revised courses of fire create a more

challenging level of marksmanship, allowing the skills of the shooter to evolve as they practice the techniques required to master Tables 3–6 of the courses of fire.

The training quality and competing requirement for a Marine's time and energy force commanders to justify sending Marines to the rifle range. The rifle range has become a check in the box event making commanders question why they should send Marines at all. Commanders are under the impression that more productive training could be conducted at the unit level with the time and resources expended by sending a Marine to the range for a week.

F. THE MENTAL CONNECTION IN MARKSMANSHIP

Mental concentration throughout the aiming and firing process is a major factor that separates novice weapons handling from professional weapons handling (Hatfield, 1987). Mind-body connection results from intense concentration on a set of tasks required to effectively engage enemy targets (Sade, Bar-Eli, Bresler, & Tenenbaum, 1990). A Marine can be taught to conduct a repeating physical action and a mental checklist in order of operations to achieve superior results each time the trigger is depressed. Through intense mental stimulation tied to physical actions the Marine develops reflex like actions that allow a faster response. The repetition of events creates neurological pathways that more rapidly stimulate the body to act appropriately while manipulating the weapon (Konttinen, Lyytinen, 1993).

Training goals in marksmanship have an underlying purpose that involves shooting enemy personnel before they have the opportunity to shoot friendly forces. Force preservation becomes a side effect of marksmanship training but is not usually captured when Marines leisurely fire at targets on a static range. When more realistic scenario based training is implemented, Marines are forced to hone their skills through intense mental focus in a time constrained environment. The mental focus must work in synchronicity with the motions of the body to produce the fastest and most accurate shots possible (Spaeth & Dunham, 1921). Putting all the elements together takes time and ultimately funding.

The costs associated with providing realistic training facilities and training aids present a difficult scenario to leadership in the Marine Corps. Commanders and their staffs always prioritize and allocate training resources to maximize the effective use of ranges and time. In many cases leadership works diligently to give each Marine the best training they have available.

The ultimate goal of marksmanship training is to provide the individual with the mental and physical ability to operate the weapon under any environmental circumstances to achieve accurate and timely employment against an enemy trying to achieve the same goal (Sade, Bar-Eli, Bresler, & Tenenbaum, 1990).

The order of operations required to rapidly prepare the weapon for firing, aiming in on the enemy, then pulling the trigger at the appropriate moment, must happen at a level of consciousness that seems autonomous to the Marine. The speed of visually acquiring the enemy, assessing the threat level, deciding to act with deadly force, raising and firing the rifle at one, or many combatants dictate the length of time a Marine has to react before being fired upon by the enemy.

The only effective means of training that has been devised to create automatic motor function is by repeating practical applications in the most realistic environment available (Kerick, Iso-Ahola, & Hatfield, 2000). When a Marines marksmanship functions have reached a level that essentially resembles autopilot, the Marine can devote his mental capacities to more important tasks such as target discrimination. Knowing when to shoot is infinitely more important than knowing how to shoot.

The Marines go to great lengths to prepare front line troops who are expected to seek out enemy personnel and eliminate them from the battlefield with the tools and techniques to conduct those missions. The most critical factor in the kill chain is the Marine’s ability to rapidly process the information in a stressful situation and make life and death decisions.

G. ADVANCEMENT IN TRAINING AND WEAPONS

Advancing the knowledge base of marksmanship has been a continuous endeavor since the first rifle was invented (Evans & Schendel, 1984). The focus of research tends to shift from static accuracy and fundamental skills training to combat focused ranges and training. The aspects of marksmanship and target engagement depart from the entry-level mechanics involved in simply operating the weapon and move acutely toward the mental focus and control of the human body while processing the environment at a masterful level of clarity (Evans & Osborne, 1998).

During advanced close quarters, battle live fire training and combat situations, training in the fundamental skills of marksmanship do not typically come to mind. The speed and overwhelming sensory overload of the situation often require a Marine to operate in an autonomous nature. Constant minor changes to the environment become major events that require action and reactionary response.

The advanced tables of fire for marksmanship training have become more comprehensive as the marksmanship experts across the Marine Corps have designed new courses of fire. In the future Marines may see more challenging and realistic scenarios to test their accuracy, agility, and speed with their primary weapons.

1. Marksmanship in Battlefield Conditions

The individual mental and physical dynamic of a single Marine in a training environment is replaced with team dynamics and geometric special awareness of the team members, civilians, combatants, and the structures or terrain. Marines who are trained to a high level of accuracy with distinctive shooting in high stress environments possess a much greater capability to operate in a similar combat environment.

The constantly evolving Marine Corps Rifle Marksmanship training program has made great strides in emphasizing realistic scenario based training events that do not rely heavily on known distance static firing positions. The addition of the Rifle Combat Optic (RCO) has been the genesis for significant changes in the skills required, and lethal capability of the Marines on the battlefield. The Marine Corps recognized the opportunity

to train to a higher standard of lethality and began to incorporate RCO shooting into the required annual training.

Previous Marine Corps rifle sights included the fixed and detachable iron sights consisting of a front site post and rear sight aperture. When firing with this more traditional rifle sight, the Marine had to make adjustments based on his knowledge of the weapons' historical point of impact. The ability to accurately engage a target was directly linked to the Marines earlier experiences with that rifles' sights. The Marine needed to know where to hold the front sight post on the target in relation to the rear sight aperture. The margin for error increased significantly with each yard the shooter is away from the target. A fraction of an inch difference in the position of the front sight in the metal ring of the rear site aperture as depicted in Figure 3 could result in several feet change in trajectory at several hundred meters.

Figure 3. Targeting with Iron Sights

Source: The Truth About Guns. (Nov. 12, 2014) Retrieved from http://www.thetruthaboutguns.com/2011/06/foghorn/ask-foghorn-competition-iron-sights/

The RCO significantly reduced the effect by providing a telescopic view of the enemy or target that would allow the Marine to more accurately engage targets at greater distances. The RCO also increased the lethality of Marines in close quarters by providing

a target acquisition capability that could rapidly be employed with both eyes open, while moving through tight urban areas.

The improvements in overall capability have been proven through years of combat where Marine accuracy with the rifle and RCO have been tested to ranges in excess of eight hundred meters with devastating effects on enemy personnel. Optically aided rifles give shooters an advantage by allowing better visibility of the target while emphasizing the movement created by the shooter in the reticle which can make a shooter more accurate then would be possible with iron sights. Figure 4 shows a Trijicon rifle combat optic that has made a drastic change to the Marine Corps standard issued rifle. The telescopic scope if utilized properly can provide a significant advantage to the shooter by magnifying the target and providing a reticle pattern sight that allows the shooter to accurately engage targets.

Figure 4. Trijicon Rifle Combat Optic

Source: Trijicon TA31RCO-A4CP ACOG 4×32 USMC Rifle Combat Optical Sight for the A4. (Nov. 20, 2012) Retrieved from http://zonhunt.com/product/trijicon-ta31rco-a4cp-acog-4x32-usmc-rifle-combat-optical-sight-for-the-a4-tj-rs-ta31rco-a4-kit2/

Static training from known distances with the rifle has been a staple training venue since the time of the musket. The simple mechanics required to load, make ready, and fire at a target within range of the weapons maximum capability have dominated

training for centuries. Minor details regarding the manner in which the weapon is held, efficiencies in movement to load and reload, as well as the simple act of maintaining a slow steady squeeze on the trigger have been evaluated throughout history to produce accuracy within the limits of the weapon being fired.

As the limits of the weapons system become less restrictive and the technology compensates for the physical effects of shooting an explosive cartridge, research should shift toward the improvement of interactions between the weapon and the shooter. The use of flash suppressors and noise dampening technologies have been proven to reduce the level of impact on a shooter or group of shooters by allowing steady engagement without the loud noises and blinding flashes produced by conventional weapons without the aid of such devises (Personal correspondence with Marines, 2012). The mental effect created by a calmer environment allows the shooter to more easily remain highly aware of the environment while eliminating potential threats.

2. Evolving the Systems Approach to Training

The Marine Corps implements a step-by-step approach to training often referred to as the "crawl, walk, run" systematic approach. The greatest drawback to this systematic tactic is the continuous turnover of Marines in every unit, which requires the crawl phase to begin again after a cycle of time relatively accompanied by the addition of new Marines to the unit from initial training venues. Marines who have progressed to the run stage often find themselves returning to the crawl stage with a new crop of Marines to their left and right. This repetition of the fundamentals becomes increasingly counterproductive and sometimes results in decreased attention to detail and loss of overall performance of the unit. Similar to this scenario, Marines who never progress past the annual rifle qualification regime become disenfranchised with the process and simply go through the required motions to complete the training without advancing to a higher level of capability than their previous year.

Understanding the motivation to learn advanced marksmanship techniques becomes key to the implementation of any training program. By taking into account previous performance on rifle qualifications to create tailored training opportunities the

Marine Corps can bring more shooters to the highest capability while reducing the overall resources expended. Marines should progress in their marksmanship capability throughout their careers by being exposed to progressively more challenging training tied to the combat readiness of the unit instead of the promotion cycle of the individual Marines. A readiness based marksmanship program would put significant emphasis on each Marines capability. Marines would progress to a higher level of skill at each range detail they attend by firing progressively more difficult courses of fire.

3. Retention of Skill

Retention of marksmanship knowledge by individual Marines cannot always be measured by performance alone. A Marine may perform all the required steps to conduct a string of fire with maximum effect on the enemy or target, yet inexplicably fall short in the impacts of his engagement due to mechanical problems with the ammunition, weapon, or otherwise unaccounted for environmental factors. Poor shooting can be attributed to many factors that can be simplified to either the mechanism or the individual. This research does not address in detail the intricate interaction between shooter and weapon that must occur to produce accurate fire. For the sake of this analysis we must assume that the Marine retained some level of knowledge from his previous training. We must also assume that the Marine performed the fundamental skills of marksmanship to a satisfactory degree to allow them to qualify at entry-level training and advance into the operating forces.

If a Marine does not generally handle weapons during his daily tasks it is likely the information required to accurately engage targets with a rifle has atrophied to some degree. Combat arms Marines typically spend more time in a training cycle handling and firing their weapons. Non-combat arms Marines often work in career fields that do not afford them frequent handling and firing of their rifles. The rifle range annual required training may be the only time some Marines have the opportunity to hone their skills.

The units that non-combat arms Marines reside are often very busy supporting operations and training leaving them little time to conduct any advanced marksmanship

training. Low density MOS Marines are often too valuable in their technical skills to lose to the rifle range for a week or two.

The fundamental skills that all Marines learn in recruit training set the stage for the remainder of their career. Marines build on those fundamentals but seldom forget the information they have learned from entry-level training. Ranges designed to reinforce fundamental shooting habits of action while introducing the shooters with new methods and tactics to achieve greater success should be the goal of Marine Corps leadership. A proven system of training has evolved for many years designed to produce excellent marksmanship from Marines at entry-level training. The Marine Corps must continue to develop marksmanship training that enforces fundamental skills while advancing the forces combat capability through improved techniques of training.

H. SUMMARY

The Marine Corps dedicates significant time and resources to establishing the foundation of fundamentals at entry-level training. Marine Corps orders have evolved to ensure entry-level training remains a strong training program that reinforces the fundamental skills of marksmanship. Sustainment training has evolved with technology but continues to focus more on sustainment of fundamentals than progression of combat marksmanship skills. Combat focused marksmanship made major changes to the Marine Corps order but lost traction with the current order. Marines who learn the fundamentals of marksmanship at entry-level training can carry forward through their career the required skills to advance in knowledge and experience. Continued adaptation of weapons, and equipment will always create a learning curve and must be addressed through adaptation of training methods to facilitate constant improvement.

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III. INSIGHT INTO DATA INTERPRETATION

A. RAW DATA COLLECTION

1. Original Data

The Marine Corps maintains data on every Marine's weapons qualifications through the Marine Corps Total Force System (MCTFS). MCTFS allows the user to create rosters of Marines based on any basic personal information such as age, rank, MOS, gender, demographics, time in service, and time at present rank. The individual information coupled with the Marine's basic training information regarding weapons qualification scores allows the researcher to observe patterns in marksmanship proficiency throughout a Marine's career. The data from MCTFS is archived in the Total Force Data Warehouse (TFDW), which can provide longitudinal data for researchers. The data allows the researcher to make basic assumptions about the ability to sustain or improve the Marine Corps lethality through the current annual qualifications policy.

The raw data from TFDW provided by Timothy Johnson from manpower and reserve affairs was received through email access to safe access file exchange files formatted in comma separated values file (CSV). The CSV files were then uploaded into JMP statistical software from a suite of analytics software (SAS) to allow data manipulation and statistical analysis of the data. The files were also manipulated in Excel to produce graphic representations of the data and conduct statistical analysis of data subsets.

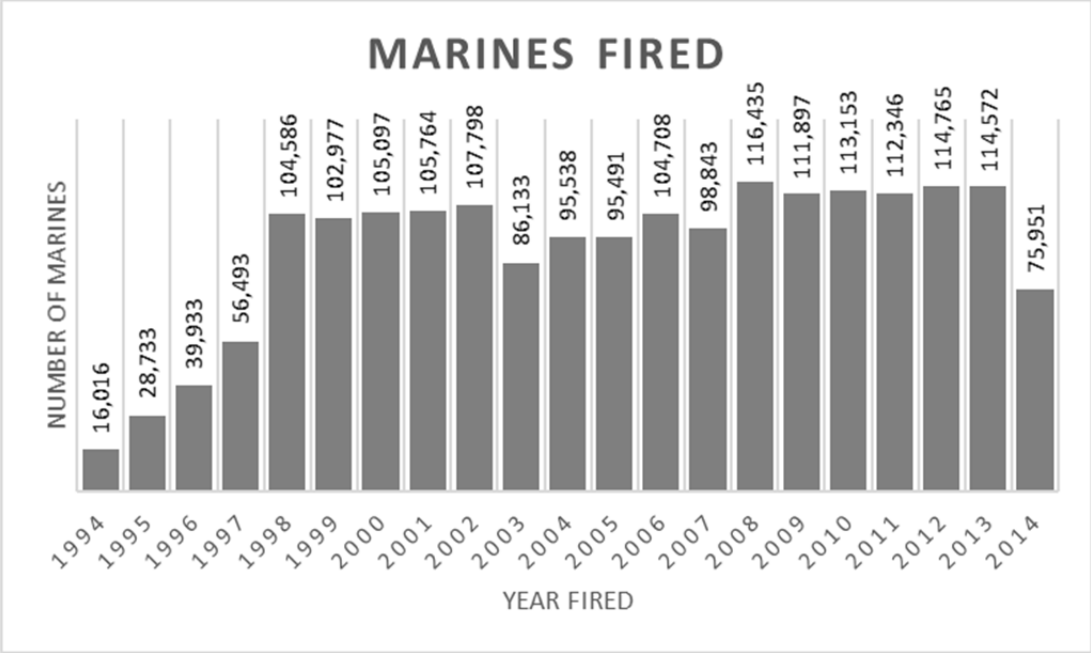
The original data set contained 1,907,229 rows of data. Each observation is a Marine's rifle score for a particular training evolution along with some limited demographic information about the Marine. The raw data categories were selected by the researcher to maintain anonymity for each record but still provide a level of clarity to the research that would allow tangible analysis.

Because it is highly unusual for a Marine to attend rifle training more than once per fiscal year, 29,245 observations were dropped from the dataset under suspicion of being duplicates. The most likely explanation for most of these anomalous entries is that

a Marine's score was entered into MCTFS, but later corrected with an additional entry. In this case, both scores would show up in our dataset. For our purposes, we retain the last score observed for each Marine for each fiscal year. Thus, the final dataset contains 1,877,984 observations. Figure 5 depicts the volume of scores each year. Marines allocate quotas for rifle range details based on fiscal year availability of funding to conduct marksmanship training.

The final data set allows researchers to compare an individual Marine from any timeframe spanning the 20-year period scores across the length of the Marine's time in service. The data set allows researchers to compare scores across several different governing Marine Corps Orders dictating the course of fire and scoring criteria for a Marine during annual rifle qualification.

Figure 5. Rifle Scores from TFDW 1994 to 2014



The final subset of data sorted and cataloged allows the researcher to compare scores from 651,293 Marines who fired more than once and recorded scores at different times during a career. The scores helped the researchers to explain an increase or decrease in marksmanship skill level during subsequent visits to the rifle range.

Lack of fully computer-based facilities may be a feasible explanation for the gradual increase of available scores as seen in Figure 6 for the years 1994–1997. The relative steady quantity of scores available as depicted by years 1998–2014 indicate that exceptional enterprise data collection was maintained throughout the years observed. The steady volume of scores also helps to verify the relative percentages of Marines attending yearly qualifications.

a. Identification

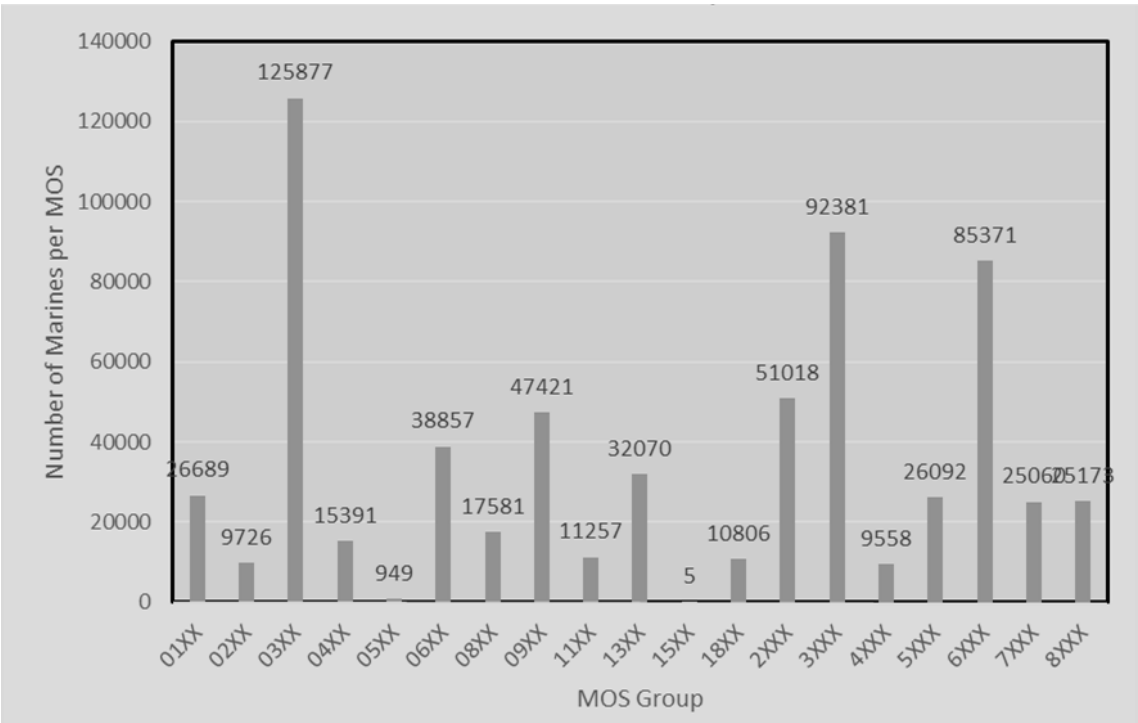
The first category provided was an identification number (ID) randomly generated and assigned to Identify each individual Marine without providing any personally identifying information. The high number of rows made these identification numbers excessively long often exceeding 15 digits. The ID numbers could be compared to identify the number of times an individual qualified during his years in the Marines. The dataset contains observations of 651,293 unique Marines.

b. Military Occupational Specialty

Each Marine's primary military occupational specialty (MOS) for each time at the range was also provided as a 4-digit number such as 0311 indicating that Marine was an infantry rifleman. The MOS of each Marine allowed researchers to sort out scores achieved by different MOS's and compare averages across different military specialties. The MOS spectrum in the data represents 610 different codes which are categorized into subcategories for like occupational specialties. Marines who are designated 01XX are generally administrative in their specialty. Marines 02XX are generally intelligence related fields. Marines 03XX are generally infantry, 04XX logistics, 05XX Marine Planners, 06XX communications. The list is extensive of military specialties and the data represents all available. Combat arms MOS's are typically more concerned with marksmanship since their primary role requires the use of weapons on a regular basis. Figure 6 divides the 610 separate MOS's into their occupational fields to represent the volume of scores from each field. Combat arms fields provide a generous volume of Marines to rifle range details. Infantry MOS's provide the highest volume yet often have the most marksmanship training outside the annual qualifications. Figure 6 depicts a

breakdown of occupational categories of Marines who fired more than once before their final rifle qualification. The graph in Figure 6 represents the volume of Marines from each occupational category that consistently conduct sustainment training.

Figure 6. Volume of Scores by Military Occupational Field



c. Present Grade

The present grade code of the Marine indicates the rank of the Marine at the time of qualification. The rank at each consecutive rifle range qualification helped the researcher separate the Marines who fired multiple times at different ranks. The data allowed the researchers to compare average scores for specific ranks at the rifle range over time. The rank also helps to indicate the number of opportunities a Marine has been given to qualify. Subsequent rifle scores as a Marine gains experience and promotions to higher ranks helps to explain the overall effective training the Marine has received during marksmanship training. Marines progress through the ranks at different speeds due to

many performance factors. The early marksmanship scores at junior ranks compared against later scores at more senior ranks help to provide analysis of the career improvement of individual Marines and subcategories. Table 1 of this document provides the volume of observations used to calculate overall statistical analysis of the data for each grade. Table 1 highlights the significantly higher numbers of observations for junior Marines keeping in line with the bottom heavy composition of the Marine Corps as a force.

Table 1. Volume of Scores by Grade 1994–2014

Grade	# of Scores	Grade	# of Scores	Grade	# of Scores
E0	3	O1	29506	W1	875
E1	356979	O1E	5357	W2	766
E2	254049	O2	18733	W3	73
E3	553843	O2E	2768	W4	15
E4	309481	O3	19982	W5	1
E5	208574	O3E	1510		
E6	109812	O4	447		
E7	4775	O5	74		
E8	325	O6	11		
E9	24	O8	1		

d. Gender

The gender associated with each row of data was provided. The data helps to establish differences that have not been closely analyzed in comparison between male and female performance in marksmanship. Separation of gender roles in the military has received significant study and produced significant controversy. The data provided by TFDW demonstrates a major statistical gap between male and female participation in the Marine Corps marksmanship program. Figure 7 displays the volume of scores available for analysis of male and female Marines. After sorting the data to eliminate duplication, the total observations of female Marines represent only 6% of the scores used for comparison of improvement. Male Marines represent a staggering preponderance of the total observations with 94% of the scores used for comparisons.

Figure 7. Gender Representation of Scores 1994–2014

Female Marines Scores	Male Marines Scores
118,908	1,759,076
6%	94%
Total Observations	1,877,984

Future research could conduct additional analysis on the data set focused directly on gender. The volume of Marines of each gender who performed multiple scores during their time in service helped researcher analyze the changes in marksmanship skill for individual Marines. Figure 8 represents male and female Marines who fired rifle qualification more than once. Female Marines who fired at entry-level training made up 7% of the total Marines who fired more than once. The 75,559 Females who only fired one time during their career made up 63.5% of females who fired at entry-level training. Male Marines who only fired once during their TIS made up 64.5% of the male score data.

Figure 8. Multiple Scores by Gender

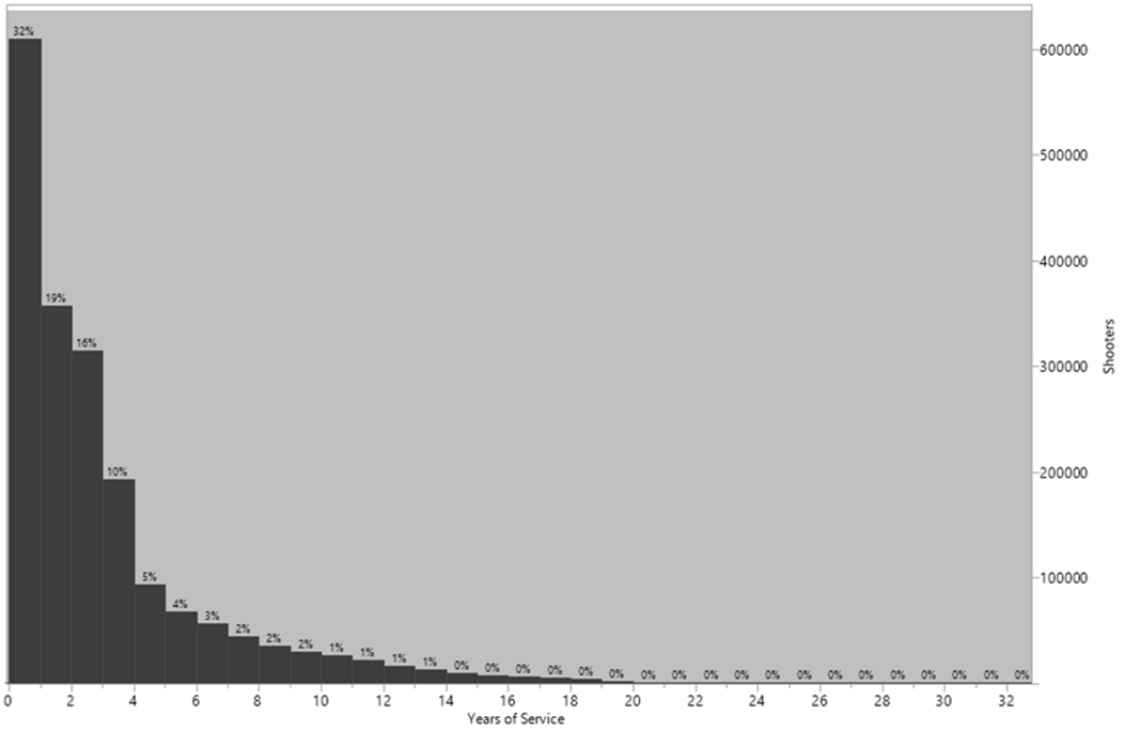
Female Marines Scores	Male Marines Scores
43,349	607,944
7%	93%
Total Observations	651,293

e. Armed Forces Active Duty Base Date

The armed forces active duty base date which indicates the first day that an individual is officially classified as having active duty status is present in the data set to allow the researchers to verify the years of service that each Marine had completed when firing the rifle for qualification. The active duty base date in conjunction with the year each rifle range score was generated allows researchers to calculate the number of years of service a Marine had when firing the rifle range. Figure 9 is a histogram that outlines

the distribution of observations by years of service. The graph may also give insight into the level of experience a Marine may have with qualification.

Figure 9. Year of Service Distribution



f. Date Fired

The date the Marine fired a qualification course and had a score recorded provided for each row of data helps the researcher sort the scores into categories of qualification based on the scores required to achieve a marksman, sharpshooter or expert qualification level. Over the 20-year timeframe covered by the research, 5 distinct Marine Corps Orders provide the guidance for the conduct of the range detail as well as the numerical criteria required for a shooter to qualify.

g. Score

Score data associated with the dates and demographic information of the individual shooter are the most important aspect of the research. The scores provide the

basis for analysis by allowing the researcher to answer the research questions about effectiveness of the marksmanship program. The score data when compared to similar scores from like time-frames, governed by like orders, allows the research to identify individual and overall trends in the development of marksmanship skills as they are represented by the Marines performance at each range.

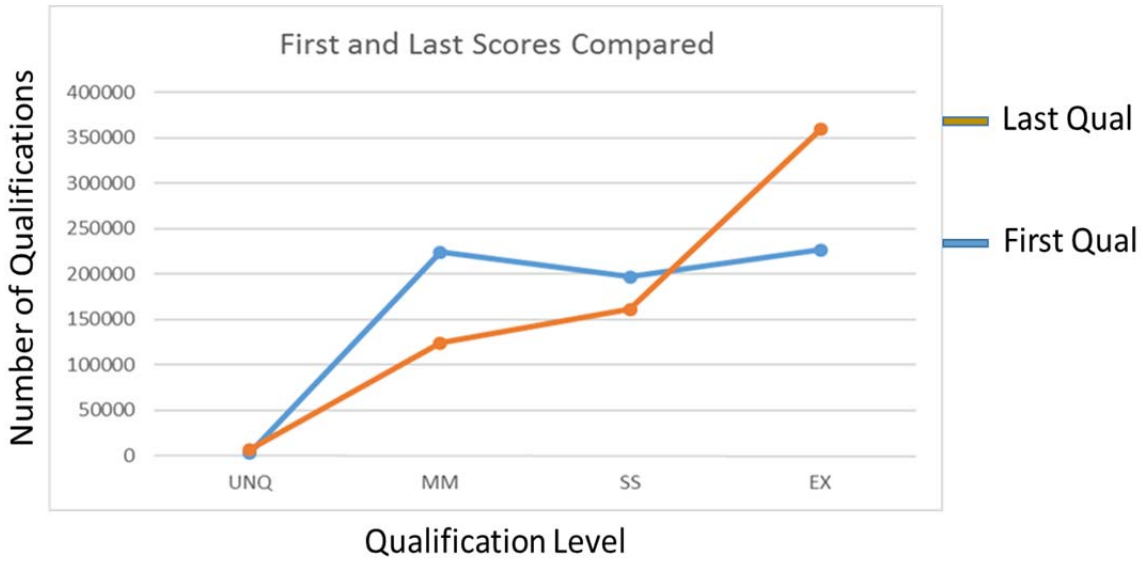
2. Data Comparisons

a. Three Qualification Levels

Comparison of unlike scores achieved from different courses of fire require additional preparations. Scaling the scores of previous qualifications into familiar categories of marksman, sharpshooter and expert allows the researcher to compare across the spectrum of rifle range details from different years. The shooting badge that a Marines wears on certain uniforms indicates the level of proficiency the individual achieved during the last annual qualification fired. The information provided by sorting the scores into the 3 categories does not provide in depth analysis into the change of marksmanship skill in the individual. Graphic depiction of the aggregate averages of scores that fall into the major categories of expert, sharpshooter, and marksman are depicted in Figure 10. Figure 10 allows the researcher to visualize the change in overall performance between the entire forces primary scores depicted in blue in comparison to the average scores achieved on the last qualification fired by the same sample of Marines depicted in brown on Figure 10.

Entry level training seems to produce higher quantities of marksman and fewer overall expert that are eventually created at the end of a Marines time on active duty. The increase in experts at the rifle range during subsequent firing does not directly equate to increasing proficiency with the rifle during range details. A high volume of Marine units conduct marksmanship training independently of range details. The unit training is more likely the contributing factor to higher scores at final qualifications. Increased experience with the weapon system may increase the skill and comfort level achieved by a Marine, ultimately resulting in better scores than original recorded at entry-level training. This may not always be true and some Marines shoot worse after entry-level training.

Figure 10. Comparing First and Last Qualifications Achieved



Adapted from Total Force Data Warehouse (TFDW) data set containing scores of all Marine Corps entry-level and sustainment rifle qualifications.

b. Sublevels within Each Qualification Level

The MCO establishing marksmanship courses of fire and standards has changed five times in the past twenty years. The scores a Marine received under a different standard do not compare perfectly to the standard from a different era. The data must be separated into timeframes that were governed by each standard and compared to like standards across the years. Table 2 of this research helps break down the scores to allow for better comparison. The statistical analysis for the total force across the entire sample is skewed by the different standards each MCO enforced at the range. Subsequently scores from different timeframes give us a general sense of degradation or improvement across the force. By looking at the general statistics during each timeframe governed by a separate order the research can make trending assumptions toward answering the questions of this research.

Separating each category into a subset of low, medium, and high helps to narrow the analysis to a more relevant result. Assigning a number value to the scale derived from subdividing the qualification levels provides a basis of analysis that can compare the entire data set of scores regardless of course of fire. Generalization of the data set into a

number from 1 to 9 to indicate the level achieved by a Marine at qualification assists the researcher in observing relative change in a Marines marksmanship. Figures 11 and 12 show the contrasting levels between male and female Marines at entry-level training. Male Marines averaged a qualification level of 4 with a numeric average of 4.64 placing them in the low sharpshooter level. Female Marines average a level 3 with an overall numeric average of 3.006 making them a medium to high marksman. Figure 11 shows that despite the average the highest volume of females shoot in the 1 category which is low marksman while the largest volume of males fire in the 7 category which is low expert.

Figure 11. Female First Qualification Levels

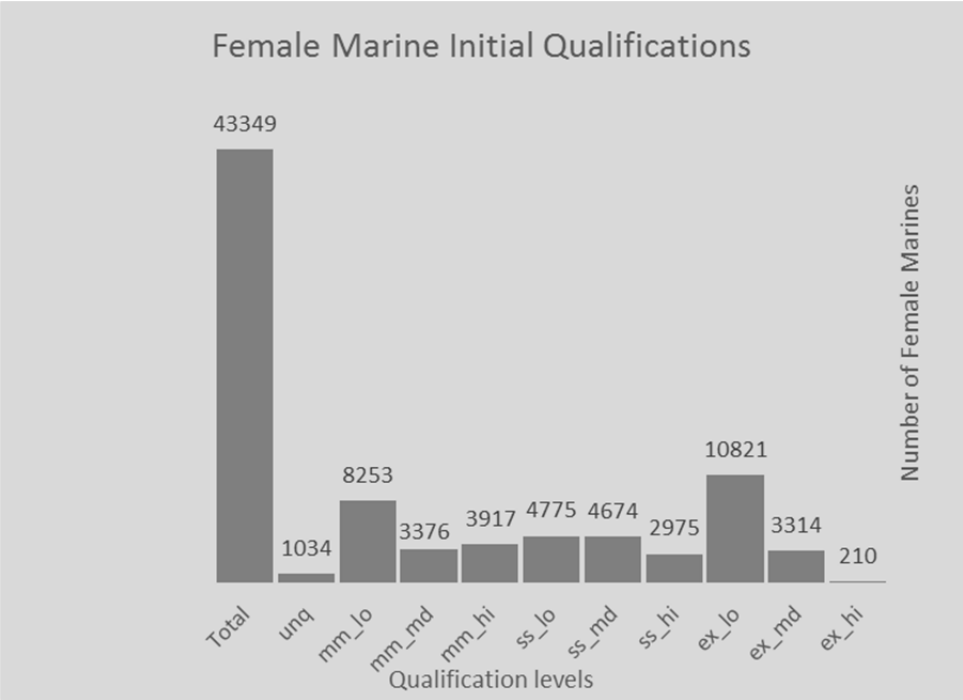
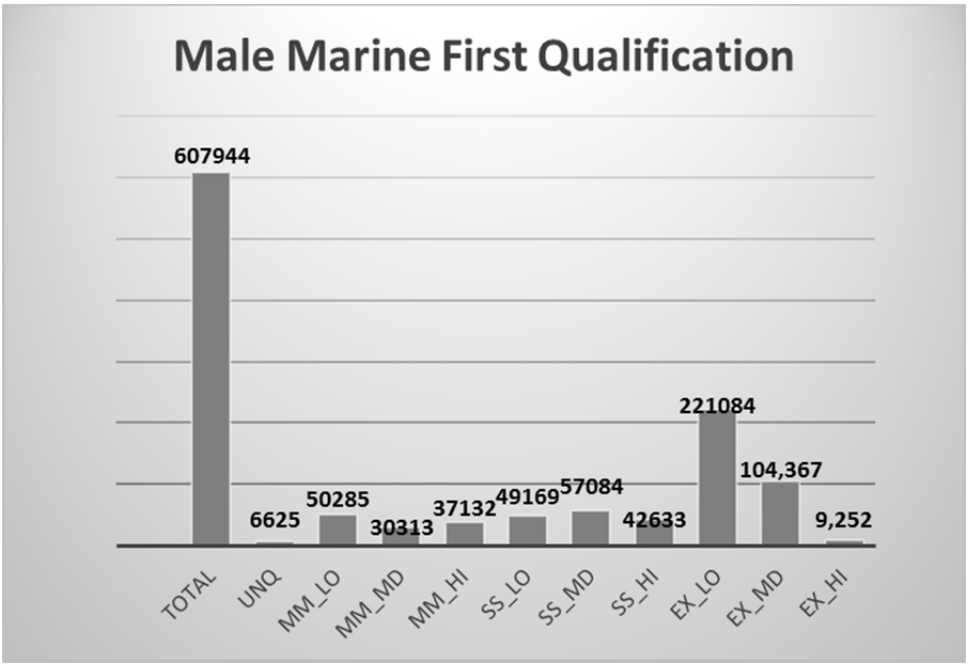


Figure 12. Male Marine Initial Qualification Levels



To compare the appropriate data sets for each subsequent year of firing, the data must be categorized into the score ranges for each level of marksmanship that is awarded. The researcher must separate the data into subcategories to better understand the effect that additional rifle range details have on marksmanship. To level the results across the separate MCO's with distinct scoring criteria, the data for each type of score is separated into marksman, sharpshooter and expert. The data is then again subdivided into thirds allowing the researcher to compare scores as being low, medium, or high in each achievement level. A Marine may have shot low expert on the hit/miss style range with a score of 45 and a low expert again on the current range detail with a score of 305. Figures 13 and 14 shows the breakdown of qualification levels of male and female Marines who fired sustainment qualification at least once during their time in service. The individual Marines could have fired 2 times or 17 times in this data set. The average number of times a Marine fires is 2.88 and these qualification levels are highly represented by second and third attempts at the rifle range. The average qualification level for female Marines at last qualification is 4.41 while the average for males rises to 5.63.

Figure 13. Female Final Qualification Levels

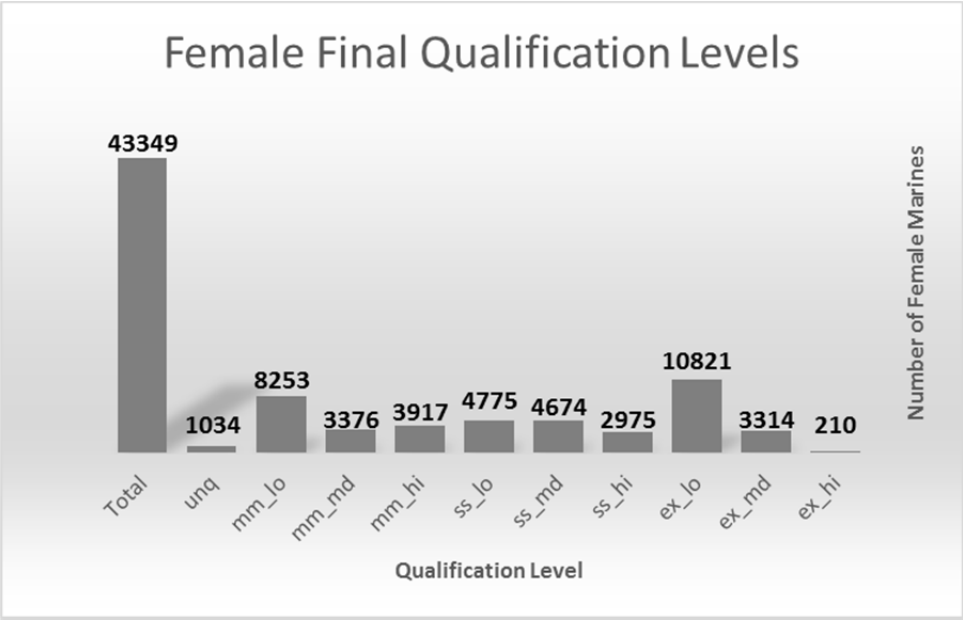
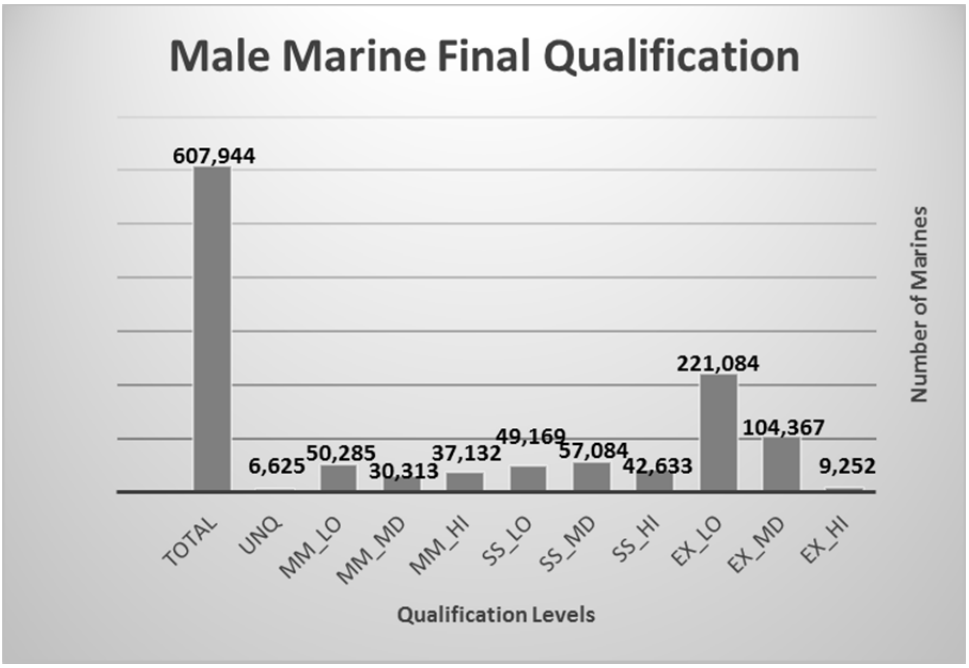


Figure 14. Male Final Qualification Levels



Despite the significant numerical value change in scores recorded during the two separate details the researcher can derive a relative assessment that the shooter did not make a significant change in marksmanship capability due to the similarity of the

qualification level. Table 2 of this document provides the basis for comparing scores across the various orders covering the period studied.

The ability to compare scores across the full spectrum of score values from each MCO allows the researcher to observe the relative improvement of Marines of different ranks, genders, and time in service. The comparisons coupled with years of observations from the researcher and observations of experts in the field of marksmanship in the Marine Corps give the researcher significant evidence toward adaptation of the marksmanship program that can be realized through restructuring of the ranges that are currently available.

Table 2 creates a threshold score that the researcher can gauge proficiency of each individual shooter based on the level achieved at qualification. Marines separate the rifle scores into these categories naturally by thirds to establish superiority with their peers.

Table 2. Threshold of Scores to Achieve Qualification Levels

	Entry Level Score qualifications								
	Marksman			Sharpshooter			Expert		
	low	Medium	High	low	Medium	High	low	Medium	High
MCO 3574.2H 11/1/94	190-196	197-203	204-209	210-213	214-217	218-219	220-230	231-240	241-250
MCO 3574.2J 6/1/99	190-196	197-203	204-209	210-213	214-217	218-219	220-230	231-240	241-250
MCO 3574.2J w/Ch 11/16/00	190-196	197-203	204-209	210-213	214-217	218-219	220-230	231-240	241-250
MCO 3574.2K 8/1/2007	250-258	260-268	270-278	280-287	289-296	298-303	305-319	321-335	337-349
MCO 3574.2L 9/4/2014	250-258	260-268	270-278	280-287	289-296	298-303	305-319	321-335	337-349
	Sustainment Level Score qualifications								
	Marksman			Sharpshooter			Expert		
	low	Medium	High	low	Medium	High	low	Medium	High
MCO 3574.2H 11/1/94	190-196	197-203	204-209	210-213	214-217	218-219	220-230	231-240	241-250
MCO 3574.2J 6/1/99	25-28	29-32	32-34	35-36	37-38	39	40-46	47-53	54-60
MCO 3574.2J w/Ch 11/16/00	25-28	29-32	32-34	35-36	37-38	39	40-46	47-53	54-60
MCO 3574.2K 8/1/2007	250-259	260-269	270-279	280-288	289-297	298-304	305-320	321-336	337-350
MCO 3574.2L 9/4/2014	250-259	260-269	270-279	280-288	289-297	298-304	305-320	321-336	337-350

Adapted from United States Marines Corps. (2014). Marine Corps Order 3574.2L (MCO 3574.2L). Washington DC: Author.

A critical assumption that allows the research to compare unlike scores over the course of a Marine's career must be made. The assumption is that the skill required to shoot at each level under different scoring ranges is relatively the same for each MCO governing marksmanship training. We must assume that a high expert score in 1994, 2004 or 2014 have been performed with approximately the same skill level. If it is more difficult to shoot high expert in 2014 than it was in 2004 or any other year, than the comparison of the scores by qualification level has much less validity. The categorization of scores effectively creates a conversion between the different range details that have been used for qualifications over the years and serves as a basis for analysis for trends across the Marine Corps.

The researcher found that rifle scores are readily available and accurately recorded by range details and recorded through the Marine Corps administrative process into the Marine Corps total force system. A significant volume of scores are available to researchers with relative ease by email correspondence with TFDW administrators. From the originally collected scores and demographic details of each individual score the researchers were able to produce subsets of data using data software to produce analysis figures and graphic representations of the total data set and several subsets of data.

3. Data Shortfalls

The Marine Corps policy takes into account the various occupational specialties necessity and ability to conduct training. Marines who are not required to fire on the rifle range do not typically go out of their way to go to the range for a week. The number of Marines who fire every year fluctuates based on the composition of the Marine Corps with respect to ranks and time in service of the total force make up. Operational tempo and competing training requirements are always a major contributing factor to the number of Marines who make it to the rifle range each year.

Fewer Marines fire for qualification during years when the Marine Corps has significant requirements to support combat operations and other unit deployments. The graph shows a significant dip in attendance to rifle range details between 2003 and 2007

that can be explained by the heavy deployment cycles of units to Afghanistan and Iraq during those years. Participation in range details climbs to its peak in 2008 as units steadily redeploy from Iraq while the Marine Corps is teaming with its highest personnel volume. The fluctuations are effected by events such as surging forces into Al Anbar, Iraq in 2007 and the draw-down of troop strengths in 2014. Units may have degraded the number of Marines required to attend qualification training during certain years as Marines respond to war and contingencies world-wide.

Marines who are not eligible for promotion due to lack of time in grade or time in service are often triaged to allow those who require cutting score point improvements based on annual rifle scores to attend. If a unit does not possess the required equipment or facilities they may not be required to qualify, which reduces the numbers of Marines who qualify.

Marines who had a score of zero recorded for their last score may have been required to qualify but did not fire due to their expressed desire to depart the Marine Corps within that fiscal year. Marines are not required to fire within 6 months of their pending end of service (USMC 2014), which is often extended by commands to free a quota on the firing detail for another Marine. It is likely the Marines who received a zero for their last score did depart the Marine Corps. Some may have remained significantly longer due to legal, medical, or administrative issues, yet never fired the rifle range again while on active duty.

The original data set contained some duplicated information that indicated an individual has fired the rifle qualification course on the same date, receiving the same score on several two of more rows. The replicated rows were discarded to remove excessive scores for an individual. The duplicated scores are not present in the final document used to analyze the scores across the total force.

B. RIFLE RANGE ATTENDANCE

1. Filling Quotas

The Marines who consistently attend annual training are represented in greatest numbers by those with fewer than four years of service. The low time in service and

implied experience is dramatically demonstrated in Figure 9, where it is noted that entry-level marksmanship training makes up a significant portion of annual qualifications.

The two largest range complexes in the Marine Corps at Edson Range, Camp Pendleton, California, and Stone Bay, Camp Lejeune, North Carolina, have the highest quantity of throughput. The high volume is attributed to entry-level training of recruits at these locations. Sustainment training after the first four years of service drops sharply during each consecutive four-year period.

The length of an average Marine enlistment is four years, which lends the study a natural timeframe over a career to separate scores. From entry-level training to the completion of the first contract the Marine is building marksmanship skills that can result in higher scores and increased points toward promotion to lance corporal and corporal.

Officers compete for career designation with their peers in the first four years. These factors are the main incentive to ensure a slot on the rifle range roster. These motivational factors may carry over into a Marine's second enlistment as the ranks of sergeant, staff sergeant, second lieutenant, and captain is attained. Figure 9 drastically displays the years of service of Marines who make up a majority of rifle range details. Most shooters are below the rank of corporal with an overwhelming majority being lance corporals.

Marines with pay grade of E3 typically have 2–5 years of active service. Marines who remain in the Marine Corps past their first enlistment typically achieve the rank of corporal or sergeant early in their second enlistment. Officers are promoted to 1st lieutenant during their first four years and achieve the rank of Captain typically within 5 years of service. The typical rank a Marine achieves during their first enlistment or contract coupled with time in service help Figure 9 show who is attending annual rifle qualifications.

The graph in Figure 9 also represents the volume of entry-level training that separates the Marine Corps as a service. All Marines must qualify at the minimum standard as a marksman before earning the coveted and relatively exclusive title of Marine. Marine Corps recruiting command continue to work diligently to maintain the

level of manpower prescribed by legal mandate. The Marine Corps end-strength is not typically affected by recruits and officers who do not qualify with the rifle. The level of supervision and training is increased on a case by case basis when an individual displays difficulty with marksmanship.

Coaches and marksmanship instructors are skilled in techniques that facilitate most shooters achieving the minimum standard. Some extra instruction and practice help to fill the gaps in capability that are needed to put a shooter over the required threshold score. A Marine might fail to qualify by a small margin during entry-level qualification but is typically be given several chances to qualify before being recycled to the next range.

2. Repetition in Training

Previous research supports annual progression of marksmanship training versus the current repetition of previous fundamental instruction. Figure 13 displays in a stark fashion the excessive volume of Marines that do not make any significant change in rifle range scores during their time in service.

Marines show more improvement then degradation in scores as observed by the smaller percentages scoring a lower level of qualification than those who achieved a higher level. The high contrast of 50% who did not improve or degrade vice those who changed qualification level helps to argue for reengineering of the marksmanship program. 75% of all Marines who fired the rifle range more than once from 1994 to 2014 fired a final score in their service that fell within two subcategories of their first score during entry-level training. The most extreme example of this would be a Marine who fired mid sharpshooter in entry-level training fired a low expert for their final qualification. The investment made to conduct sustainment training is not significantly improving the capability of the force.

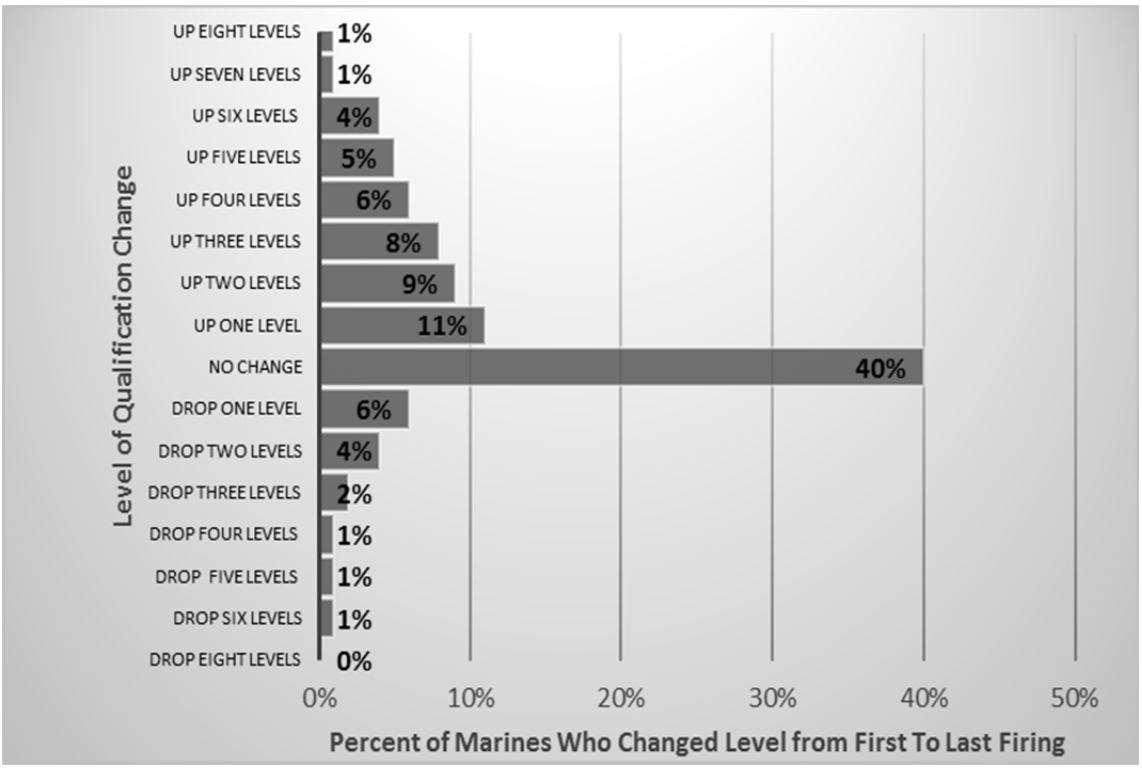
Summary statistics associated with Figure 13 is derived from the difference between first and final scores of 651,293 individual Marines showed that the mean change achieved between qualification categories is 1.02. If a Marine fires as a low marksman at entry-level training, on average that individual will fire a medium

marksman score for the last time they qualify in the Marine Corps. The standard deviation of the sample is 2.4 and standard error of the mean .003. This analysis displays a marginal improvement in marksmanship capability on average over a career no matter how many times a Marine has fired the qualification courses.

The marksmanship program is sustaining marksmanship skills received at entry-level training. Marines are remaining highly capable throughout their time in service regardless of the volume of training received past entry-level training. The volume and type of training should be transformed to reflect the retention of skills that we have already observed in a Marine's earliest iterations of training. Adapting the marksmanship program to capitalize on available advancements in training techniques could produce greater capability than has already been achieved.

Marine marksmanship is exceptional in almost every respect. Improvements in the program can sometimes seem inconceivable. The high level of training and constant procedural repetition may lead to stagnation if continuous evaluation is not addressed. The technical skill and concentration required to perform during every string of fire is ultimately what creates the difference between a marksmanship, sharpshooter, or expert. Marines take personal pride in the level of marksmanship achieved on the rifle range. The researchers must assume that the differences observed during a Marine's subsequent scores are due to improvement or degrading application of fundamental skills. Figure 15 represents the change that Marines generally make over their time in service. The trend in the data shows that a striking majority of Marines do not make a significant change in their scores from the first to the last rifle range attempt.

Figure 15. Relative Percentage of Change in Score Category

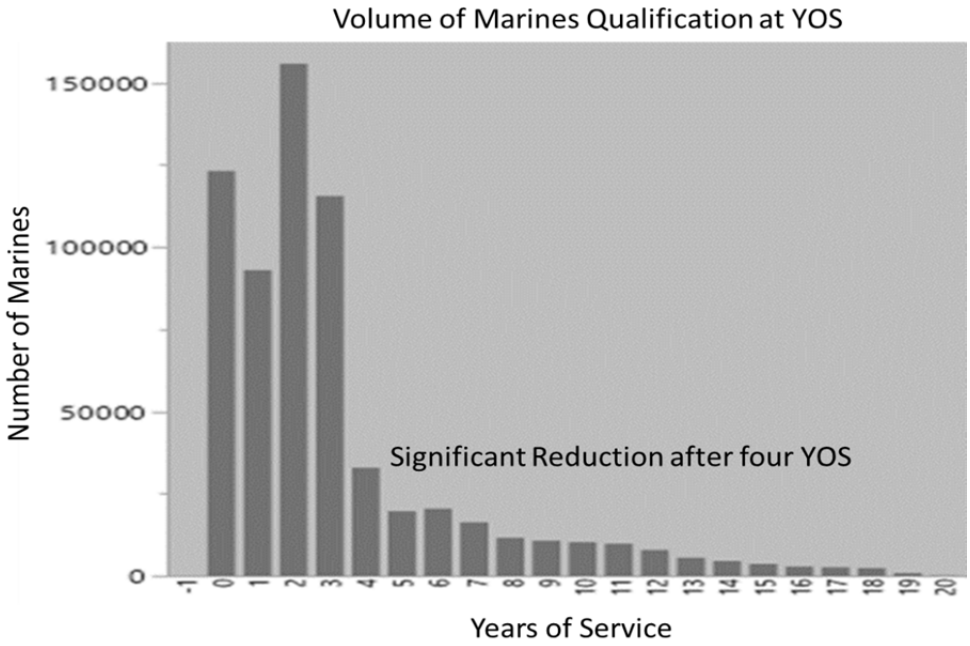


The research has focused on the composition of rifle ranges shooters over the full duration of their career. Figure 16 depicts the time in service that Marines who fired more than once had at their last rifle range during their tour on active duty. The results demonstrate the high volume of Marines with 2 years of service who never fire again during their career. A total of 155,920 Marines of the 651K who fired more than once, fired for the last time at two years of service. These Marines complete their annual sustainment within their first or second term of service and do not improve as a whole more than a few points over subsequent iterations. The last time 487,898 Marines fired the rifle range while they wore the uniform fell within four years of the day they entered the Marine Corps. Figure 16 helps identify the trend that occurs over the years of fulfilling rifle range quotas with junior Marines.

3. Bottom Heavy Marine Corps

The heavily lopsided range attendance highlights the strong turnover of junior Marines and the hierarchical structure of the Marine Corps. The volume of junior Marines firing their last qualification represents the Marine Corps bid for success in a shooting war. The Marines who perform a majority of the fighting are likely in their first enlistment under the watchful eye of Marines of senior ranks.

Figure 16. Years of Service at Last Qualification



Marine Corps policy should adapt to the changing trends in Marksmanship retention to allow for advanced training to occur at a higher frequency then presently available. The remediation of fundamental marksmanship skills should be tailored to Marines who exhibit degraded skill during testing in simulation.

The ammunition and time spent during annual qualification courses could be reallocated to training events that can advance the marksmanship capabilities of the individual Marine in more realistic combat simulation scenarios. This adjustment would specifically target non-infantry Marines, but would also apply to the training plans of

infantry units by realigning funds, ammunition, and range times to a constantly evolving regimen of advancing marksmanship skills.

4. Range Availability

The Marine Corps maintains twelve primary locations where Marines are allocated quotas to conduct qualification with the rifle. Year round operations are not conducted at any of these locations due to the heavy support requirements, ammunition, maintenance, and other environmental and organizational limitations. A rifle qualification course of fire is typically conducted over a week long evolution often maximizing the capacity of the range for that timeframe. The firing line on most Marine Corps ranges have 50 firing points, each firing point can safely accommodate a single shooter who is assigned a firing lane.

At the end of the range is the pits, depicted in Figure 17, a covered berm behind which the mechanisms used to raise and lower target stands are housed. Marines operate the target stands shown in Figure 17 by hand. The Marine physically pushing targets up and down to expose the target to the shooter on the range. Very little has changed in the operation of the pits target system for many years. Most ranges can accommodate firing from dawn to dusk when weather permits. The efficiency of the range crew determines the number of Marines who can fire in a single day.

5. Ownership

Tables of fire as outlined in the MCO require different target types and range configurations. The ranges themselves require adjustment to fire subsequent courses of fire. More advanced courses of fire require targets that move at known distances or range set up that allows the shooter to move along the range while shooting. These additional target requirements and control measures constitute an investment in time and resources that are not currently allocated to Marine units outside the infantry.

The incorporation of the Table 2 course of fire to the annual rifle range is seen by most as an attempt to advance the combat marksmanship skill level of the total force. The Table 2 course of fire adds an extra day, which did not get the appropriate amount of

attention and professional focus until the current MCO tied Marines total qualification score to their Table 2 firing score.

Currently training above Table 2 is encouraged but not required by non-combat arms units. (USMC 2014). Range facilities must be scheduled separately by individual units when time and ammunition is available to conduct follow on training. Units bear the burden of establishing ranges that can accommodate the advanced marksmanship training. (C. Beltran, personal communication, 2015). The 12 primary ranges are not manned or equipped to conduct sustainment training above Table 2 on a regular basis. (V. Pope, personal communication, 2015).

The requirement for target feedback creates issues at night when Marines are firing on steel targets at unknown distances in low light conditions on a firing line. A Marine can hear the audible ping of the round striking the steel target from distances greater than 800 meters. The problem becomes distinguishing one ping from the many others ringing out in on the range.

Figure 17. Target Stands in the Pits at a Rifle Range

Source: Parris Island Museum. Training and Education Command, United States Marine Corps. http://www.tecom.marines.mil/Photos/tabid/5048/igphoto/241454/Default.aspx

The automation of the pits is an expensive and highly technological endeavor that could increase the output of the range by eliminating the human interaction with the

actual targets. Continued advances in target recording impacts and other digital technologies to stream-line the process of firing on the rifle range could fill several volumes but is not a focus of this research. The Marine Corps has traditionally gotten by with what was available and hesitates to spend tax payer dollars on material solutions that seem unnecessary for the time being. Table 3 shows the allocated resource breakdown for the FY14 rifle range details across the marine Corps. The Marine Corps for this specific year allocated ranges, ammunition, personnel, equipment, and time to 113,256 shooters. Units across the Marine Corps sent 82,409 to conduct rifle qualification. Reporting gaps and administrative inaccuracies give the reports themselves a level of discrepancy that is not addressed.

The 12 primary venues also host unit training when time is available. Qualification of marksmanship instructors must be taken into account when discussing the range utilization. To be able to conduct rifle range training in any capacity the Marine Corps must maintain a cadre of Marines with the knowledge and skills to instruct shooters during the week prior to firing known as “Grass Week,” and during the week of firing on the rifle ranges. (USMC 2014)

Table 3. Annual Range Utilization Report 2014

MTU LOCATION	DETAILS FIRED	ALLOCATED QUOTAS	QUOTAS NOT USED	PERSONNEL TRAINED	AVG SCORE	AVG T1	AVG T2	INITIAL QUAL%	FINAL QUAL%	# EX	EX%	#SS	SS%	#MM	MM%	#UNQ	UNQ%
MTU STONE BAY, MCB CLNC	37	28914	4581	22402	287.52	207.93	79.58	83%	91%	11116	50%	6937	31%	1278	6%	1711	8%
MTU CAMP PENDLETON, CA	36	30459	9592	20273	309	215	98	95%	97%	13223	65%	5353	26%	682	3%	1015	5%
MTU CAMP HANSEN, OKINAWA	39	11860	1469	10391	303	213	91	95%	95%	7065	68%	2597	25%	207	2%	207	2%
MTU MCAGCC, 29 PALMS, CA		8780	2795	5990	295	212	83	90%	92%	2965	49%	2115	35%	413	7%	477	8%
MTU MCAS MIRIMAR, CA		5938	917	5021					100%	3320	66%	1624	32%	31	1%	46	1%
MTU MCB HAWAII		7800	4456	4456	302	211	82	84%	95%	2661	60%	1529	34%	265	6%	256	6%
MTU MCAS CHERRY POINT, NC	20	4560	1424	4216	301	214	88	85%	92%	2247	53%	1193	28%	335	8%	80	2%
MTU MCRD PARRIS ISLAND, SC	19	5567	1598	3969	301.49	212.69	92.21	94%	98%	2423	61%	1210	30%	205	5%	131	3%
MTU MCAS YUMA, AZ	25	3750	1356	2349	320	222	97	99%	100%	2100	89%	214	9%	35	1%	0	0%
MTU WTBN QUANTICO, VA	7	2100	525	1575	308.59	216.81	91.49	97%	97%	1081	69%	424	27%	68	4%	48	3%
MTU DAM NECK, VA	12	1728	602	1126	317.95	224.21	93.73			731	65%	250	22%	91	8%	54	5%
MTU EDSON RANGE, CA	7	1800	1159	641	310.27	217.94	93.26	97%	99%	493	77%	124	19%	18	3%	6	1%
REPORTABLE	202	113256	30474	82409	3355.82	215.144	89.934	92%	96%	49425	60%	23570	29%	3628	4%	4031	5%

6. Ignored Factors of Marine Corps Marksmanship Scoring

Marine Corps rifle ranges primarily utilized to conduct qualification firing are located around the world. The primary ranges are located at Marine Corps Base Camp Pendleton, California; Marine Corps Base Camp Lejeune, North Carolina; Marine Corps Base Quantico, Virginia; Marine Corps Base Camp Hansen, Okinawa, Japan; and Marine Corps Base 29 Palms, California. The physical conditions, and environmental factors of the ranges at each of these locations can play a major factor in the scores achieved by Marines firing on the ranges. Environmental factors such as cold weather, excessive rain, mud, heat, humidity, gravel, sand, dirt, grass, and wind can all play a role in every shot fired during a rifle range detail. Marines learn to work around the environmental conditions to achieve the best possible score during their qualification day. Despite best efforts the scores for a single firing day may be affected by these environmental factors. This study has chosen to ignore the environmental differences between scores and assume that volume of information smooths out any irregularities in the data.

Marines do not always qualify with the highest score they are capable of achieving. Firing on a rifle range detail is conducted over a five-day firing period. Marines who apply the fundamental skills and maintain a properly filled out data book of their shot record through practice firing sessions can usually fire at their most proficient on the last day of qualification fire. Some Marines can lose focus on the final day of fire and lose points by firing less accurately during a specific string of fire then they had previously done.

7. Rifle Scores Focused Research

Marksmanship is a highly complex, physically and mentally challenging endeavor in the most accommodating conditions. Historical research has dissected the mechanics required for a human being to fire a weapon and strike an intended target with relative certainty (Chung et al. 2004). The research focuses on the overall trends of the data sample. The scores that are recorded during the Marine Corps qualification courses have potential errors. Range personnel strive to provide shooters with accurate assessment of

their shooting ability. Marines assigned to provide shot hole spotting and scoring are closely regulated but may make mistakes from time to time during their time in the pits.

The researcher must assume that over the past 20 years of range details that similar errors have occurred in relatively the same quantities in a generally normal distribution across the 12 range complexes where a majority of qualification is administered. By looking at the scores the research can take face value assessments without overcomplicating the research with the dozens of factors that influence an individual Marines shooting capability from year to year. By focusing closely on a few factors such as years of service and grade in relation to the score that was performed the data becomes manageable at just under two million rows of data.

The courses of fire that a Marine must perform to reach an aggregate score are outlined in each MCO governing the timeframe the Marine fired. Courses of fire have changed over the years and must be analyzed separately before scores can be compared across time. The current scoring criteria from the USMC's *MCO 3574.2L* provides the longest source of scores derived from a similar course of fire.

Unqualified	Marksman	Sharpshooter	Expert
0–249	250–279	280–304	305–350

a. Marines must obtain a minimum score of 190 on Table 1A evaluation in order to proceed to Table 2 training and evaluation. After successfully completing Table 1A, the Marine will proceed to Table 2 training.

b. Marines must obtain a minimum score of 60 on Table 2 evaluation in order to receive an aggregate qualification score. Marines who do not obtain a minimum score of 60 on Table 2 will not meet the annual rifle qualifications. Upon successfully completing Table 2 training on the first attempt, the Marine will receive an aggregate qualification score. (2014, p. 7–4)

C. EXEMPTIONS AND WAIVERS

The Marine Corps currently allows Marines who fall into specific criteria to be granted a waiver from conducting rifle range training. The exemptions outlined in the MCO present several opportunities for commanders to conduct other critical tasks with the Marines that would otherwise be required to attend a minimum of five days firing

Table 1A and Table 2 in the MCO. Marines who are perpetually granted waivers based on the MCO can in some cases go many years without firing the rifle. In these cases, it is likely those Marines have not improved significantly as a marksman since initial training.

1. Exemptions

The circumstances that can allow a Marine to receive exemptions and waivers to annual rifle marksmanship training are outlined specifically in *MCO 3574.2L* to provide commands with criteria for assigning a quota to the range detail for that year. The excerpt from the MCO helps to justify the lack of participation in marksmanship training.

> Circumstances that Warrant Exemption. There are circumstances that warrant a Marine to be exempt from completing annual marksmanship training. Commanders have the authority to grant exemptions only for the circumstances listed in this Order. Per the commander's discretion, any Marine exempt per this Order can and should be afforded the opportunity to complete annual marksmanship training. Commanders may grant exemptions for the following circumstances:
>
> (1) Marines assigned to units with no rifles on their table of equipment (T/E).
>
> (2) Marines awarded the Distinguished Marksman Rifle Badge. Distinguished Rifle Marksmen are not exempt from Tables 2, 3 and 4. A Table 2 score will not be reported for Distinguished Riflemen.
>
> (3) Marines who are serving in the last 6 months of their enlistment, unless they have indicated their intention to reenlist or extend, are exempt from annual qualification.
>
> (4) Officers holding the grade of O-4 or higher, unless the officer is issued a rifle/carbine as their T/O weapon. If the rifle/carbine is their T/O weapon, these Marines will conduct live fire training on Table 3 and Table 4, as applicable, with their units.
>
> (5) Officers with 13 years of service or more, unless the officer is issued a rifle/carbine as their T/O weapon. If the rifle/carbine is their T/O weapon, these Marines will conduct live fire training on Table 3 and Table 4, as applicable, with their units.
>
> (6) Enlisted Marines holding the grade of E-7 or higher, unless their T/O weapon is a rifle/carbine. If the rifle/carbine is their T/O weapon, these Marines will conduct live fire training on Table 3 and Table 4, as applicable, with their units.

> (7) Marines who qualify expert for 2 consecutive years are eligible for a 1-year exemption from firing. This exemption must be granted by commanding officers at the company level or higher; based on demonstrated proficiency, training, deployment schedules, and other factors deemed applicable. Marines granted this exemption will be required to fire during the next fiscal year and every other year thereafter while the Marine maintains an expert classification and is granted an exemption by their commander. Marines who qualify less than expert will be required to fire expert 2 consecutive years in order to be eligible for the exemption again. b. Exemption Procedures. Once authorized, exemptions require an administrative function from the unit. The unit must provide a roster to the unit's administrative section listing the exempted Marines and request the code "EEE" be entered as their annual rifle qualification score. (2014, pp. 6-9–6-10)

2. Waivers

The process for obtaining a waiver for an individual Marine or entire unit is described in detail in *MCO 3574.2L*. The excerpt from the text of the document allows the researcher to justify the annual participation as it is recorded.

> a. Waivers from the requirements of this Order may be solicited only for short-term situations that temporarily prevent an individual, group, or entire unit from completing annual training. The intent is for units to request a waiver when it is determined that time or the lack of sufficient resources will prevent an individual, group, or entire unit from accomplishing the required annual marksmanship training. The purpose of granting waivers is to protect individual Marines who were legitimately unable to complete required annual training from being adversely affected.
>
> b. Waivers must state the circumstances preventing an individual, group, or unit from completing annual marksmanship training and what steps are being taken by the unit to resume annual marksmanship training. A unit requesting a "blanket waiver" for the whole unit is not permitted. Waiver requests must be submitted with a by name roster of all individuals needing a waiver. Waivers will only be good for the fiscal year requested.
>
> c. The authority to waive training rests with the following Commanders:
>
> (1) Marine Forces Command (COMMARFORCOM).
>
> (2) Marine Forces Pacific (COMMARFORPAC).
>
> (3) Marine Force Reserves (COMMARFORRES).
>
> (4) Marine Corps Combat Development Command (MCCDC).

(5) Marine Corps Special Operations Command (COMMARFORSOC).

(6) For separate organizations not commanded by a general officer, authorization to waive training must be obtained from the CG, Marine Corps National Capitol Region Command (MCNCRC).

(7) Commanders of organizations that fall under TECOM will submit any waiver requests to CG, MCCDC (C476S) via the chain of command.

d. For activities that are not tenants of Marine Corps posts or stations, and the local range facilities are not suitable for firing standard Marine Corps courses of fire, waivers may be submitted to the CG, MCCDC (C476S) prior to the conduct of training. This request shall state what capabilities the available facilities possess and what attempts have been made to acquire access to a suitable range as defined in this Order. CG, MCCDC (C476S) has the authority to authorize a modified course of fire to fit range capabilities. (2014, pp. 6-9–6-11)

3. Conservation of Resources

Exemptions and waivers translate to training dollars. Each Marine that is granted an exemption or waiver saves the Marines Corps significant expense that could be redistributed to more critical training. The expenses to conduct sustainment level marksmanship training as it is designed today involves the Marines salary, salary of range personnel, opportunity cost of all involved in planning, preparing and administering a range detail. Ammunition, transportation cost, reduction in the life of the weapon system, and more costs are going to be incurred by the Marine Corps regardless of course of fire. All of the resources required to simply sustain existing skills could be used to improve practical combat marksmanship through advanced training and simulation. The overall effect of adapting to a steadily improving course of fire requirement is a higher overall effective shooter in each Marine with only the additional cost burden of range restructuring.

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IV. ANALYSIS OF PROGRESSION

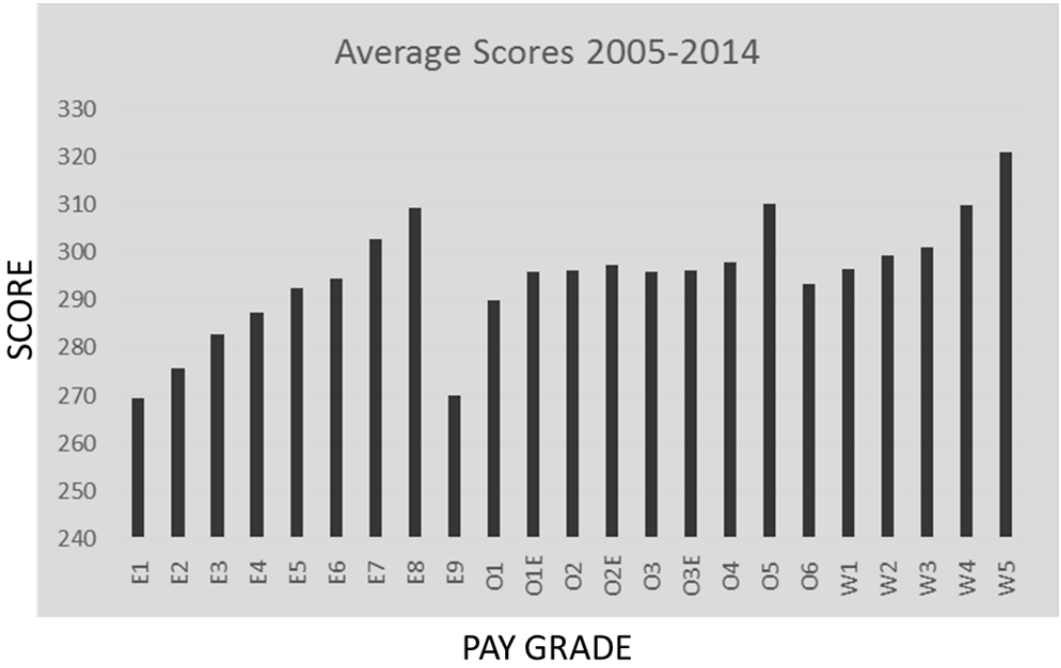
The focus of this research is the progression of the entire force over a 20-year period. Individual Marines who evolve through the Marine Corps at different time-frames in recent history have similar experiences with certain subtle and major changes. The Marine Corps has evolved rapidly over the past 20 years and several different versions of Marine Marksmanship training have been implemented to evolve with the demand for speed, accuracy of fire in a combat situation.

Recent history of scores across the Marine Corps depicted in Figure 18 shows on average a steady progression in scores as a Marine achieves higher ranks with a distinct drop among E9s who are understandably occupied with management of Marine Corps affairs vice increasing their individual marksmanship proficiency.

In many cases, E8 and E9 Marines do not attend the “snap in” preparation training that occurs the week before a rifle range detail due to their demanding management roles. The resulting average scores as shown in Figure 18 suffer from limited time and focus on marksmanship among senior staff and officers. The averages depicted in Figure 18 only allow broad assumptions to be made as to the increase of a Marine’s marksmanship skills over a career.

Detailed analysis of the progression of individual scores may better be able to gauge the effective use of Marine Corps resources. The overall end state of analysis is to provide a salient argument for revision of the Marine Corps Order pertaining to marksmanship training.

Figure 18. Average Scores between 2005 to 2014



Adapted from Total Force Data Warehouse (TFDW) data set containing scores of all Marine Corps entry level and sustainment rifle qualifications.

The average number of times a Marine attends rifle range sustainment throughout a career regardless of length of service is 2.88, rounded to 3 times. A Marine's career track tends to proceed in such a way that often rifle range details are not available every year. If a Marine does not have a rifle on the units' table of equipment (T/E), then per the MCO the Marine is not required to qualify. Marines typically attend formal schooling during their first 6 months and up to 2 years after completing entry-level training during which time they typically do not fire.

A. HAVE MARINES IMPROVED?

Marines progress through their career firing the rifle range when required once they have reached the operational forces. Rifle range quotas are distributed to each unit to fulfill the numbers required to ensure all Marines who need a score for their professional advancement has the opportunity to go.

The Marine Corps policy has allowed for such a significant number of exemptions and waivers to annual training that it becomes easier for many Marines to refrain from shooting any weapon at all. Marines in formal schools that do not have the requirement or ability to conduct marksmanship training seldom attempt to seek out such venues due to the lack of funding or ammunition allocation. Waivers are granted in accordance with the MCO to account for many special circumstances throughout the force.

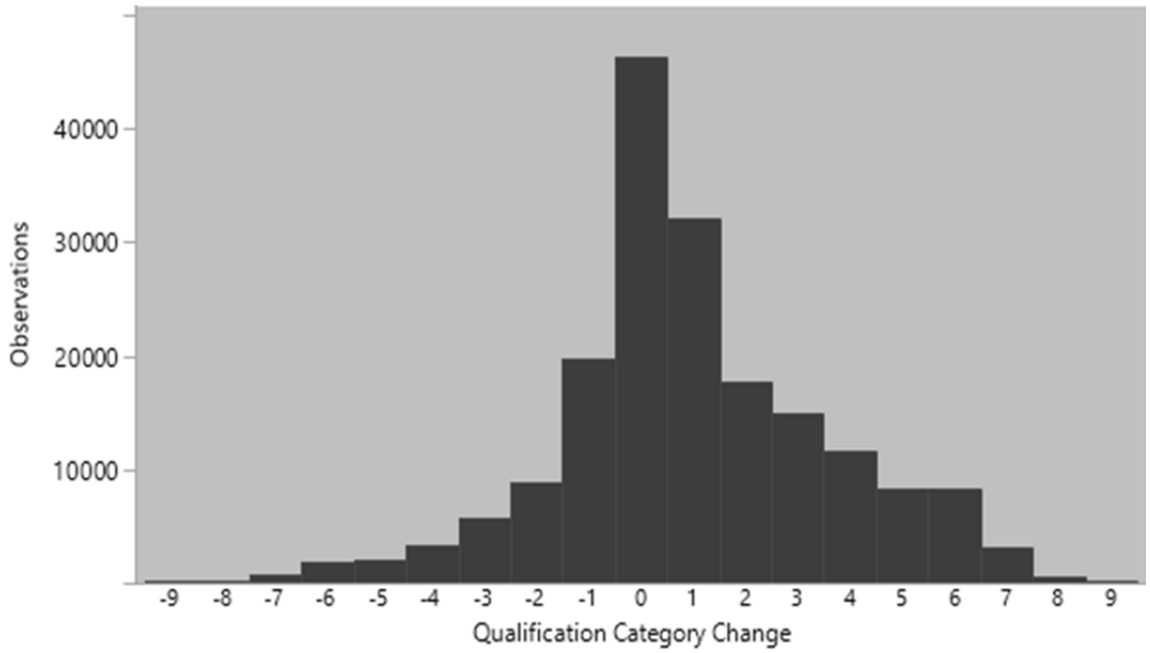
Infantry Marines attempt to incorporate live fire training as much as possible. Often attending rifle range details to shoot Tables 1 and 2 interrupts training that could be significantly more beneficial to the unit as a whole. Given that a majority of Marines are shooting at a high level across their careers, sending to them to the rifle range when a unit needs to conduct mission essential training can be a struggle for commanders. Figure 19 graphically represents the qualification levels of 182,289 Marines who have fired for a score from 1994 through 2014 who had previously qualified two times regardless of time between range details. Sorting the scores into the qualification categories allows the research to show that a large volume of Marines fired at level 7, depicting low expert, and level 8, medium expert, on their third range detail across all MOS's.

Figure 19. Qualification Level at Third Qualification

Adapted from Total Force Data Warehouse (TFDW) data set containing scores of all Marine Corps entry level and sustainment rifle qualifications.

To compare improvement achieved if a Marine continues to fire subsequent rifle range details the researchers separated scores of shooters who had fired more than 3 times on the rifle range. The score category achieved by each Marine was compared against that Marines final qualification while on active duty to produce a numerical representation of the change in qualification level Marines achieved. The resulting graphic representation of the change between a Marines qualification level on their third qualification and the last qualification can be observed in Figure 20. Descriptive statistics derived from the analysis used to create Figure 20 shows that of the 182,289 Marines who fired more than 3 times during their time in uniform, 25% had no change to their qualification level. Marines who degraded by one category, remained the same, or improved by a single category made up 47% of all Marines who fired subsequent ranges.

Figure 20. Difference in Qualification Level from Third to Last Qualification



Adapted from Total Force Data Warehouse (TFDW) data set containing scores of all Marine Corps entry-level and sustainment rifle qualifications.

Over the past 20 years, approximately 651,293 Marines have fired the rifle qualification more than a single time. The average number of times these individuals have fired the rifle qualification course is 2.88 times during their time to date in the Corps. The average years of service for someone in the data set who fired their last recorded score is 3.17 years, which further confirms that the junior ranks are attending a preponderance of range details.

Grouping similar score ranges and observing the overall trends loses some precision in analysis but allows the research to focus on higher volumes of test subjects overall. Like scores fired on a similar range since October 1 2007 to present day help to show the trends in the eight years without requiring a Marines score to be separated into qualification subcategories.

1. Typical Marksmanship Improvement

Comparison of score averages across years of service helps to describe the relative plateau that occurs after six years of service. Average scores of 1,002,144 during the period from 2005 to 2014 show a distinct leveling of scores across all ranks. The marginal difference of average scores between a Marine with 8 years of service vice 13 years is 1.43 points.

The average score for a Marine at 4 years of service during this timeframe is 287.17 points at high sharpshooter. If a Marine improved 5 points rounded up to get to the overall average of 291.94 rounded to 292, would keep the Marine firmly inside the high sharpshooter range. Average scores do improve slightly with an increased number of years of experience. The increase in average is less than six points and still under the threshold of an expert score of 305. The highest average score occurs at 13 years of service which is the last year in service most Marines are required to qualify under the current policy.

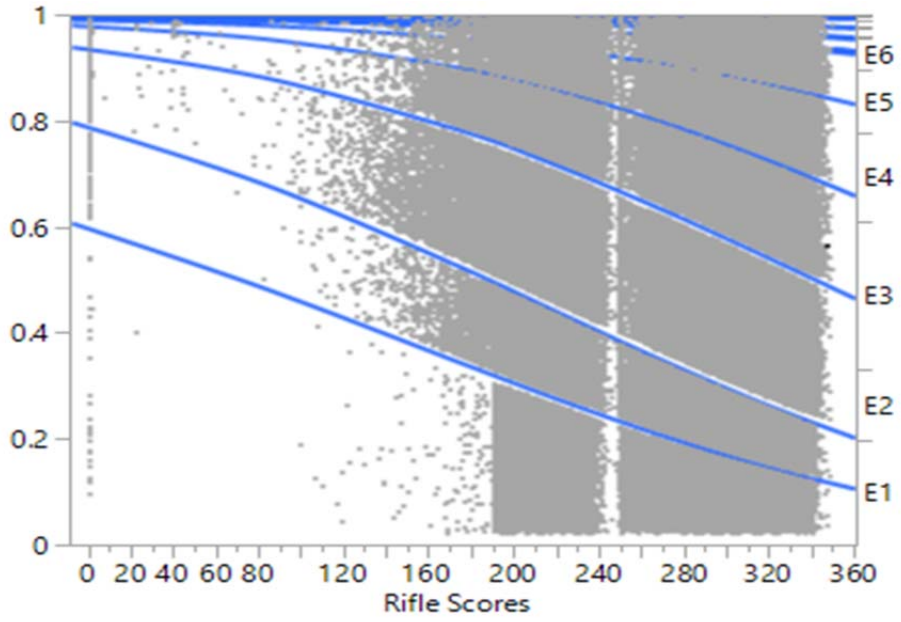
Recognizing and interpreting a pattern of scores created by the grading criteria and threshold scores is natural for most Marines who have fired the rifle range and conducted the duties of a scorer in the pits. Range personnel attempt to control any assistance that might be given to a Marine by his fellow shooters in the pits when a shot is questionably placed. Shot scoring is procedural and supervised but can be circumvented by some when a few points could mean the difference between the shooter qualifying at a higher level or just making the score to qualify marksman.

2. Score Keeping

A general contempt for being in the pits may cause enough malice to ensure the Marine firing does not get any breaks from his scorer in the pits. Figure 21 highlights distinct patterns that appear that suggest Marines recording shot holes and scores in the pits during rifle qualifications are acutely aware of the margins between qualifying scores. Marines spotting shot holes and recording the respective scores from the target to the score card may favor toward specific scores while making judgement calls on shot placement.

The individual scores of 1,877,984 observations spanning the full 20-year period help to highlight overall trends regardless of MCO governing the score, or the level of proficiency of the Marine. The distinct lack of scores below 190 points for E1and E2 shooters reflected in Figure 18 can be partially explained by the level of attention given to entry-level shooters by range staff. Entry level Marines may require significant focused initial training to develop the fundamental skills required to qualify.

Figure 21. Pattern Analysis



The threshold to qualify as a marksman during entry-level training for each era is displayed in Table 2 as 190 points from 1994 to 2007. The threshold to qualify as a marksman from 2007 to present day is 250 points. The pattern of the scores shown in Figure 20 showing distinct vertical lines at these threshold scores supports the hypothesis that Marines involved in range details are keenly aware of the threshold scores that their fellow shooter on the firing line needs to qualify with.

The shooter on the firing line becomes the score keeper for the Marine on target detail when it becomes time to rotate duties. The range administrators are acutely aware of possible corruption of scores by Marines trying to help their fellow shooters and often take steps to alleviate familiarity between shooters and score keepers. The efforts to ensure objective scoring are not always effective.

3. Oversight

Providing oversight for range details is significantly challenging and rely heavily on the integrity of the individual Marines to provide objective scoring. The shooter on the firing line becomes the score keeper for the Marine on target detail when it becomes time to rotate duties. The range administrators are acutely aware of possible corruption of

scores by Marines trying to help their fellow shooters and often take steps to alleviate familiarity between shooters and score keepers. The efforts to ensure objective scoring are not always effective.

Officers and staff NCO's are assigned as range verifiers to supervise the conduct of the Marines keeping score in the pits on pre-qualification and qualifications days of firing. The perceived additional burden levied on units to provide officers and staff NCO's for rifle range details can contribute to a general lack of attention to detail among the cadre assigned to ensure accuracy.

The repetitive nature of the range detail does not provide the motivation to excel in training standards by the unit since the training is out of their control. Providing unit leadership with the ranges, responsibility, and resources to conduct intermediate and advanced training would eliminate the lack of ownership that often plagues traditional rifle range details.

Ownership of training allows units to customize training toward the level of capability required by the unit which may eliminate the trend of scores seen in Figure 21 generated by simply achieving a qualifying score to check the box.

4. Perception of Hit-Or-Miss Style Qualification

The author observed a perception of relative simplicity among the infantry community during range details where the hit-or-miss style course of fire was being implemented. The author generally believed Marines thought the hit-or-miss range was easier to score expert on than other courses of fire previously implemented.

Previous qualification courses of fire and scoring criteria may have sustained basic skills but lacked the progression needed to better the combat focused marksmanship of the individual Marine. The hit-or-miss course seemed like a step in the right direction toward combat shooting focused training but may have lacked some focus on the traditional sustainment of fundamentals. The current course of fire attempts to continue to evolve with Table 1A focused on fundamental marksmanship while Table 2 course of fire focuses more on combat scenario based shooting.

The data analysis comparing the level of shooting proficiency between the hit-or-miss style range and the current range qualification standards show a different scenario than what may be expected. The author having observed each form of rifle range qualification over the past 20 years developed a null hypothesis that the hit-or-miss course of fire was easier to achieve a higher qualification level than the current qualification.

The researchers compared the proportional difference between expert qualifications achieved during the times covered by each MCO to compare the volumes of each level against different qualification courses. The comparison shows that more Marines are proportionally shooting expert on the current qualification course than the hit-or-miss qualification course. The current course of fire has resulted in 418,638 experts, 59% of the 714,743 Marines, who have fired between 2007 and 2014. During the period covered my hit-or-miss 418,828 Marines fired the range with only 176,460, 42% achieving the level of expert. The perception that hit-or-miss qualification is easier to achieve a higher score seems to be false and we must reject the null hypothesis.

Combat arms units who regularly conduct combat scenario based training may believe the hit-or-miss training is easier since it shares similarities in techniques with the normal unit training.

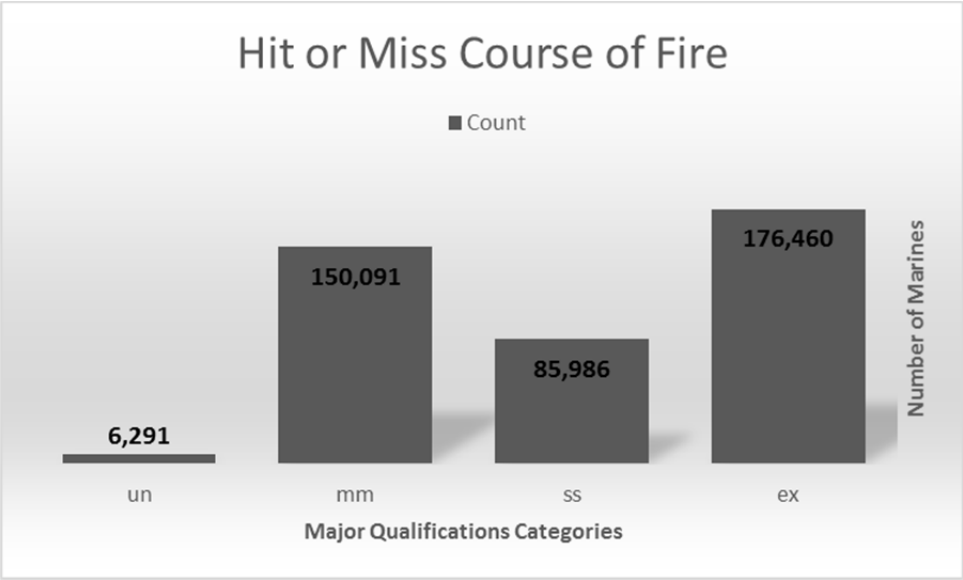
Non-combat arms units may have a different perception due to the infrequent combat marksmanship training they receive. Figure 22 and Figure 23 can be compared to highlight the trends in qualification level for hit-or-miss with the current scoring indicating a trend of higher scores on the conventional rifle range scoring system.

Figure 22. Qualification Levels of Marines 2007–2014

The relatively high volume of marksman shooters in Figure 23 during the hit-or-miss qualifications at 36% compared to the much lower 12% shown in Figure 22 during the current qualification ranges indicate the hit-or-miss course of fire was more difficult.

A combat focused course of fire seems to have been a more challenging course than what is currently in place. The course of fire tables provided as Table 3 of this document outline the techniques and mastery of new courses of fire that can foster continued progression of marksmanship skills through a Marines time in service. Combat functional shooting skills may be more difficult to master as is indicated by the comparison of past performance. The increased level of difficulty will ensure that Marines train to a higher standard of marksmanship skill while enforcing the fundamentals and improving the force overall.

Figure 23. Hit-Or-Miss 2000–2006



B. INTANGIBLE FACTORS

The crack of rounds overhead makes a distinct sound that is not easily replicated. Marines take turns working the target stands in the pits while relays of 50 Marines at a time take aim and fire at the targets just above their heads. The snap of rounds as they pass overhead and the distant sound of rifle fire over the berm give the Marines the experience of being fired at in the few ways that that can be safe. The time on the rifle range is often spent following orders from the center line cart where directions are given to the Marines on the firing line. Firing live rounds creates a sensation in the human body that is difficult to experience in any other situation.

A Marine has the opportunity to become comfortable with the sounds, smells and feelings of firing live ammunition on the rifle range. Desensitization to the environmental factors helps the Marine process the information without experiencing sensory overload (Espinosa 2008). This effect of live fire is the most important intangible effect of firing on the rifle range. This study does not suggest that Marines should shoot less. More time on the range for all Marines is the ultimate goal. The statistical analysis of scores from Marine rifle ranges over the past twenty years provide the basis for the researcher's argument to provide more challenging intermediate and advanced training. The research

does not intend to reduce the volume of range time a Marine receives. The range time available for each Marine should be better spent learning new skills and practicing more realistic scenario based training to take the shooters to new levels every time they fire their weapon.

The substantiate the change in training philosophy this research intends to highlight trends in performance at the rifle range across the Marine Corps. Recognizing trends of marksmanship at an individual and Corps level earlier may allow for future resources to be allocated to advancement of skill level instead of sustainment.

The research compiles available rifle scores with the Marines rank, time in service when firing, and previous range performance to demonstrate the effectiveness of the annual marksmanship qualification policy. The analysis focus primarily on the overall changes in Marines rifle range performance in relation to time in service and rank information, the study provides evidence toward restructuring the Marine Corps annual rifle qualification policy.

V. OBSERVATIONS, CONCLUSION, AND RECOMMENDATIONS

A. OBSERVATIONS

1. Answering the Research Questions

Can the Marine Corps adjust the marksmanship policy to better reflect individual marksmanship capability? The data analyzed for this research provides evidence to support change in the current policy. If annual qualification remains to be repetitive and infrequent, Marines will continue to display little to no progression in the skills they developed at entry-level training.

An appropriate benchmark should be developed based on higher level tables of fire that would indicate a Marines continued progression as a shooter throughout their time in the service.

Intermediate and advanced marksmanship training could be provided in substitute for the current sustainment focused training program. The Marines who have shown proficiency in the fundamentals by qualifying as marksmen possess the fundamental skills required to continue advancing through more complex courses of fire.

2. Progressive Qualification

The data paints a clear picture of slow progression due to lack of continuous participation in marksmanship training. A significant trend exists in marksmanship training over the past 20 years that suggests that policy anchored in tradition and fundamentals has prevented continuous adaptation and overall improvement in the lethal capability of the Marine Corps with the most essential weapons in its arsenal.

The evaluation of all rifle range scores derived from the total force from 1994–2014 has helped to explain the distribution of ranks and experience of Marines who typically attends annual qualification training. If the goal of the Marine Corps marksmanship program is to squander valuable resources reinforcing the skills learned

during entry-level training without improvement for each Marine, then it seems to have succeeded.

Over the years rifle range details have changed in many ways. Weapons, equipment, optics, and ammunition has evolved. The most significant evolution has been the Marines themselves. Generations of Marines from various backgrounds have come and gone. Few Marines have remained over the past twenty years enduring countless days of combat in two wars and a number of conflicts. The caliber of recruit has risen to higher levels than has been seen before. The newest generation of Marines are challenged with greater responsibility than the last and the Marine Corps can achieve higher levels of combat efficiency by employing marines to the highest potential at every endeavor.

Rifle marksmanship remains a key element in combat readiness across the armed forces and must adapt with the Marines who train to defend themselves and fight enemies around the world. Readiness can be the focus of training with marksmanship at a higher level than currently mandated.

B. CONCLUSION

The Marine Corps could better allocate available resources by conducting fewer sustainment ranges focused on the level 1A and level 2 courses of fire by reducing the required number of Marines who must fire those levels. Reallocating ammunition and range time to Tables 3–6 training depicted in Table 3 of this document would advance Marines throughout their career.

The Marines who are typically attending the annual qualifications are heavily represented by junior ranks with relatively low time in service. Marines who have attained mid to higher ranks have typically reached near maximum level of proficiency under the current rifle qualification course. The dramatic drop in participation of senior ranks indicates that there is already a natural tendency to avoid repetitive training.

Marines want to excel as marksmen frequently spending off duty hours increasing their individual proficiency with personal weapons. Training time is finite and must be tightly controlled in most units to achieve the overall goals of that unit. In non-infantry

units where weapons handling and employment is not a regular even, Marines may only have a single week to sustain and improve the skills they acquired over their first years as a Marines.

The data provided in this research supports reducing the requirement of annual qualification on Tables 1A-2 to Marines at entry-level training and conduct sustainment consisting of intermediate and advanced courses of fire to increase readiness in the unit while surpassing sustainment regardless of rank.

The resulting effect on Marine Corps Marksmanship would be an overall increase in combat marksmanship proficiency with the Marine Corps primary weapon systems. As a Marine progress through their carrier, sustainment of fundamental marksmanship skills would give way to a continuous evolution. The resulting effect would be that every Marine could potentially reach a new height in marksmanship capability every year similar to the constant improvement in capability that is seen with infantry units as they become more seasoned.

C. RECOMMENDATIONS

Readiness based training should be the focus of effort in marksmanship training and sustainment. Courses of fire that gradually challenge the Marine to achieve a greater proficiency during each consecutive visit to the range. By establishing a threshold of proficiency for each table of fire, the Marine Corps can track the level of marksmanship for a specific Marine throughout their career. Replacing promotion points with readiness levels places a greater focus on each Marine's proficiency with the weapon to achieve an overall goal of unit readiness to conduct combat operations.

Marines with four years or less in the Marine Corps make up a majority of the range details under the current system. A large majority of Marines can shoot at a high level of skill by the time they have qualified for the second time in the Marine Corps. Continuing to qualify on the same range with the same firing tables allows the Marine to go through the same actions as were performed on previous details.

Marines should only fire Table 1A and 2 courses in entry-level training. Each time a Marine conducts annual qualification during the following sustainment period, the Marine should fire the next table to a level of mastery that would signify preparation to move on to the next higher table. Marines can then participate in intermediate and advanced marksmanship training as directed by commanding officers in preparation for contingencies or scheduled deployments.

Table 4. Revised Tables of Fire: Table 2–Table 6

Revised Table 2 BCM Training							
Stage	Meter Line	Drill	Rounds per Iteration	Time	Position(s)	Iteration	Rounds
Zeroing	100	Zero	15	N/A	Prone	1	15
Stage 1 Position refinement	25	Controlled Pair	2	5 SEC	Standing	5	10
		Controlled Pair	2	5 SEC	Kneeling	5	10
Stage 2 Standing	25	Pelvic Shot	1	5 SEC	Standing	4	4
		Controlled Pair	2	5 SEC	Standing	4	8
		Failure to Stop	3	5 SEC	Standing	4	12
Stage 3 Kneeling	25	Pelvic Shot	1	5 SEC	Kneeling	4	4
		Controlled Pair	2	5 SEC	Kneeling	4	8
		Failure to Stop	3	5 SEC	Kneeling	3	9
Stage 4 Speed Reload	25	Controlled Pair	4	7 SEC	Standing	2	8
		Controlled Pair	4	7 SEC	Kneeling	2	8
Stage 5 Movers (Standing)	100	Movers Right	2	10 SEC	Standing	5	10
		Movers Left	2	10 SEC	Standing	5	10
Stage 6 Movers (Kneeling)	100	Movers Right	2	10 SEC	Kneeling	5	10
		Movers Left	2	10 SEC	Kneeling	5	10
						Total	136

Revised Table 2 BCM (Pre-Evaluation/Evaluation)							
Stage	Meter Line	Drill	Rounds per Iteration	Time	Position(s)	Iteration	Rounds
Stage 1 Movers (Kneeling)	100	Movers Right	2	10 SEC	Kneeling	2	4
		Movers Left	2	10 SEC	Kneeling	2	4
Stage 2 Movers (Standing)	100	Movers Right	2	10 SEC	Standing	2	4
		Movers Left	2	10 SEC	Standing	2	4
Stage 3 Speed Reload	25	Controlled Pair	4	7 sec	Standing	2	8
		Controlled Pair	4	7 sec	Kneeling	2	8
Stage 4 Standing	25	Pelvic Shot	1	5 sec	Standing	1	1
		Controlled Pair	2	5 sec	Standing	1	2
		Failure to Stop	3	5 sec	Standing	2	6
Stage 5 Kneeling	25	Pelvic Shot	1	5 sec	Kneeling	1	1
		Controlled Pair	2	5 sec	Kneeling	1	2
		Failure to Stop	3	5 sec	Kneeling	2	6
						TOTAL	50

TABLE 3 UNKNOWN DISTANCE, DAY (TRAINING)							
STAGE	METER LINE	DRILL	ROUNDS PER ITERA-TION	EXPOSURE TIME	POSITION(S)	ITERA-TION(S)	TOTAL ROUNDS
ZEROI NG	100	ZEROING EXERCISE	5	1 MIN	PRONE	3	15
MID RANGE	40-60	ENGAGE UNTIL DOWN	4	20 SEC	SUPPORTED STANDING	1	4
MID RANGE	90-110	ENGAGE UNTIL DOWN	4	20 SEC	SUPPORTED KNEELING	1	4
MID RANGE	140-160	ENGAGE UNTIL DOWN	4	20 SEC	SUPPORTED KNEELING	1	4
MID RANGE	180-200	ENGAGE UNTIL DOWN	4	20 SEC	SUPPORTED KNEELING	1	4
LONG RANGE	200-300	ENGAGE UNTIL DOWN	4	20 SEC	SUPPORTED PRONE	1	4
LONG RANGE	300-400	ENGAGE UNTIL DOWN	4	20 SEC	SUPPORTED PRONE	1	4
LONG RANGE	400-500	ENGAGE UNTIL DOWN	6	30 SEC	SUPPORTED PRONE	1	6
						TOTAL	45

TABLE 3 UNKNOWN DISTANCE DAY (PRE-EVALUATION AND EVALUATION)							
STAGE	METER LINE	DRILL	ROUNDS PER ITERA-TION	EXPOSURE TIME	POSITION(S)	ITERA-TION(S)	TOTAL ROUNDS
MID RANGE	40-60	ENGAGE UNTIL DOWN	4	20 SEC	SUPPORTED STANDING	1	4
MID RANGE	90-110	ENGAGE UNTIL DOWN	4	20 SEC	SUPPORTED KNEELING	1	4
MID RANGE	140-160	ENGAGE UNTIL DOWN	4	20 SEC	SUPPORTED KNEELING	1	4
MID RANGE	180-200	ENGAGE UNTIL DOWN	4	20 SEC	SUPPORTED KNEELING	1	4
LONG RANGE	200-300	ENGAGE UNTIL DOWN	4	20 SEC	SUPPORTED PRONE	1	4
LONG RANGE	300-400	ENGAGE UNTIL DOWN	4	20 SEC	SUPPORTED PRONE	1	4
LONG RANGE	400-500	ENGAGE UNTIL DOWN	6	30 SEC	SUPPORTED PRONE	1	6
						TOTAL	30

TABLE 4 UNKNOWN DISTANCE NIGHT (TRAINING)							
STAGE	METER LINE	DRILL	ROUNDS PER ITERA-TION	EXPOSURE TIME	POSITION(S)	ITERA-TION(S)	TOTAL ROUNDS
ZEROING	100	ZEROING EXERCISE	5	1 MIN	PRONE	3	15
MID RANGE	40-60	ENGAGE UNTIL DOWN	5	20 SEC	SUPPORTED STANDING	1	5
MID RANGE	90-110	ENGAGE UNTIL DOWN	5	20 SEC	SUPPORTED KNEELING	1	5
MID RANGE	140-160	ENGAGE UNTIL DOWN	5	20 SEC	SUPPORTED PRONE	1	5
MID RANGE	180-200	ENGAGE UNTIL DOWN	5	20 SEC	SUPPORTED PRONE	1	5
						TOTAL	35

TABLE 4 UNKNOWN DISTANCE NIGHT (PRE-EVALUATION AND EVALUATION)							
STAGE	METER LINE	DRILL	ROUNDS PER ITERA-TION	EXPOSURE TIME	POSITION(S)	ITERA-TION(S)	TOTAL ROUNDS
MID RANGE	40-60	ENGAGE UNTIL DOWN	5	20 SEC	SUPPORTED STANDING	1	5
MID RANGE	90-110	ENGAGE UNTIL DOWN	5	20 SEC	SUPPORTED KNEELING	1	5
MID RANGE	140-160	ENGAGE UNTIL DOWN	5	20 SEC	SUPPORTED PRONE	1	5
MID RANGE	180-200	ENGAGE UNTIL DOWN	5	20 SEC	SUPPORTED PRONE	1	5
						TOTAL	20

TABLE 5 SHORT RANGE DAY (TRAINING)							
STAGE	METER LINE	DRILL	ROUNDS PER ITERA-TION	TIME	POSITION(S)	ITERA-TION(S)	TOTAL ROUNDS
ZEROING	100	ZEROING EXERCISE	5	1 MIN	PRONE	3	15
SHORT RANGE STAGE 1	5	HEAD SHOT	1	5 SEC	STANDING	3	3
		HAMMER PAIR	2	5 SEC	STANDING	2	4
		FAILURE TO STOP	3	5 SEC	STANDING	1	3
SHORT RANGE STAGE 2	10	HEAD SHOT	1	5 SEC	STANDING	3	3
		HAMMER PAIR	2	5 SEC	STANDING	2	4
		BOX DRILL	6	5 SEC	STANDING	1	6
		FAILURE TO STOP HEAD	3	5 SEC	STANDING	1	3
SHORT RANGE STAGE 3	15	PELVIC	1	5 SEC	STANDING	3	3
		HAMMER PAIR	2	5 SEC	STANDING	2	4
		BOX DRILL	6	5 SEC	STANDING	1	6
		FAILURE TO STOP PELVIC	3	5 SEC	STANDING	1	3
SHORT RANGE STAGE 4	25	PELVIC	1	5 SEC	STANDING	3	3
		CON-TROLLED PAIR	2	5 SEC	STANDING	2	4
		BOX DRILL	6	5 SEC	STANDING	1	6
		FAILURE TO STOP PELVIC	3	5 SEC	STANDING	1	3
SHORT RANGE STAGE 5 FWD MVMNT	25-15	BOX DRILL	6	N/A	FWD MOVEMENT	1	6
	15-10	FAILURE TO STOP PELVIC	3	N/A	FWD MOVEMENT	1	3
	10-5	FAILURE TO STOP HEAD	3	N/A	FWD MOVEMENT	1	3
						TOTAL	85

TABLE 5 SHORT RANGE DAY (PRE-EVALUATION AND EVALUATION)							
STAGE	METER LINE	DRILL	ROUNDS PER ITERA-TION	TIME	POSITION(S)	ITERATION(S)	TOTAL ROUNDS
STAGE 1	25	CON-TROLLED PAIR	2	5 SEC	STANDING	2	4
		BOX DRILL	6	5 SEC	STANDING	1	6
		FAILURE TO STOP PELVIC	3	5 SEC	STANDING	1	3
	25-15	BOX DRILL	6	N/A	FWD MOVEMENT	1	6
STAGE 2	15	HAMMER PAIR	2	5 SEC	STANDING	2	4
		BOX DRILL	6	5 SEC	STANDING	1	6
		FAILURE TO STOP PELVIC	3	5 SEC	STANDING	1	3
	15-10	FAILURE TO STOP	3	N/A	FWD MOVEMENT	1	3
STAGE 3	10	HAMMER PAIR	2	5 SEC	STANDING	2	4
		HEAD SHOT	1	5 SEC	STANDING	1	1
		BOX DRILL	6	5 SEC	STANDING	1	6
		FAILURE TO STOP HEAD	3	5 SEC	STANDING	1	3
	10-5	FAILURE TO STOP HEAD	3	N/A	FWD MOVEMENT	1	3
STAGE 4	5	HAMMER PAIR	2	5 SEC	STANDING	2	4
		HEAD SHOT	1	5 SEC	STANDING	1	1
		FAILURE TO STOP HEAD	3	5 SEC	STANDING	1	3
						TOTAL	60

TABLE 6 SHORT RANGE NIGHT (TRAINING)							
STAGE	METER LINE	DRILL	ROUNDS PER ITERA-TION	TIME	POSITION(S)	ITERATION(S)	TOTAL ROUNDS
ZEROING	100	ZEROING EXERCISE	5	1 MIN	PRONE	3	15
STAGE 1	5	HEAD SHOT	1	5 SEC	STANDING	3	3
		HAMMER PAIR	2	5 SEC	STANDING	2	4
		FAILURE TO STOP	3	5 SEC	STANDING	1	3
STAGE 2	10	HEAD SHOT	1	5 SEC	STANDING	3	3
		HAMMER PAIR	2	5 SEC	STANDING	2	4
		BOX DRILL	6	5 SEC	STANDING	1	6
		FAILURE TO STOP HEAD	3	5 SEC	STANDING	1	3
STAGE 3	15	PELVIC	1	5 SEC	STANDING	3	3
		HAMMER PAIR	2	5 SEC	STANDING	2	4
		BOX DRILL	6	5 SEC	STANDING	1	6
		FAILURE TO STOP PELVIC	3	5 SEC	STANDING	1	3
STAGE 4	25	PELVIC	1	5 SEC	STANDING	3	3
		CONTROL LED PAIR	2	5 SEC	STANDING	2	4
		BOX DRILL	6	5 SEC	STANDING	1	6
		FAILURE TO STOP PELVIC	3	5 SEC	STANDING	1	3
STAGE 5 FWD MVMNT	25-15	BOX DRILL	6	N/A	FWD MOVEMENT	1	6
	15-10	FAILURE TO STOP PELVIC	3	N/A	FWD MOVEMENT	1	3
	10-5	FAILURE TO STOP HEAD	3	N/A	FWD MOVEMENT	1	3
						TOTAL	85

TABLE 6 SHORT RANGE NIGHT (PRE-EVALUATION AND EVALUATION)							
STAGE	METER LINE	DRILL	ROUNDS PER ITERA-TION	TIME	POSITION(S)	ITERATION(S)	TOTAL ROUNDS
STAGE 1	25	CONTROLLED PAIR	2	5 SEC	STANDING	2	4
		BOX DRILL	6	5 SEC	STANDING	1	6
		FAILURE TO STOP PELVIC	3	5 SEC	STANDING	1	3
	25-15	BOX DRILL	6	N/A	FWD MOVEMENT	1	6
STAGE 2	15	HAMMER PAIR	2	5 SEC	STANDING	2	4
		BOX DRILL	6	5 SEC	STANDING	1	6
		FAILURE TO STOP PELVIC	3	5 SEC	STANDING	1	3
	15-10	FAILURE TO STOP	3	N/A	FWD MOVEMENT	1	3
STAGE 3	10	HAMMER PAIR	2	5 SEC	STANDING	2	4
		HEAD SHOT	1	5 SEC	STANDING	1	1
		BOX DRILL	6	5 SEC	STANDING	1	6
		FAILURE TO STOP HEAD	3	5 SEC	STANDING	1	3
	10-5	FAILURE TO STOP HEAD	3	N/A	FWD MOVEMENT	1	3
STAGE 4	5	HAMMER PAIR	2	5 SEC	STANDING	2	4
		HEAD SHOT	1	5 SEC	STANDING	1	1
		FAILURE TO STOP HEAD	3	5 SEC	STANDING	1	3
						TOTAL	60

Adapted from Personal communication with V. Pope, Director of marksmanship doctrine and program management, weapons training battalion, Headquarters Marine Corps 2015.

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VI. SUGGESTED FOLLOW-ON RESEARCH

Randomly selected recruits could provide a significant sample population to measure the relative effectiveness of a new marksmanship program. The average scores obtained by a control group firing the currently prescribed program can be compared and analyzed against the performance of the experimental sample. A longitudinal study of the improvement of the two groups could give insight into any new program effectiveness. The data collection over a four-year period would help to ensure an experiment that represents the realistic changing conditions experienced by a Marine conducting sustainment marksmanship training.

The Marine Corps has adapted its use of the M16 style weapon many times. Early versions of the M16 were fully automatic. New automatic rifles such as the Marine Corps Infantry Automatic Weapon (IAR) have been reintroduced to infantry units in recent years and been fielded to units deploying to combat. Future studies into the evolution of marksmanship may study the effects of training with fully automatic individual weapons on the overall accuracy of the individual Marine.

Marine units are often constrained by time when training for future contingencies. Future research may attempt to define the optimal training volume to produce maximum effective marksmanship in infantry units. During a truncated pre-deployment training cycle, a Marine unit may be forced to prioritize essential training time to cover specific mission essential task training. In this scenario, what types of marksmanship training would be most beneficial to the unit.

What overall effects might the transition to a shorter, lighter, M4 rifle have on overall Marksmanship in the Marine Corps? Does a lighter weapon improve marksmanship stability in smaller stature Marines?

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